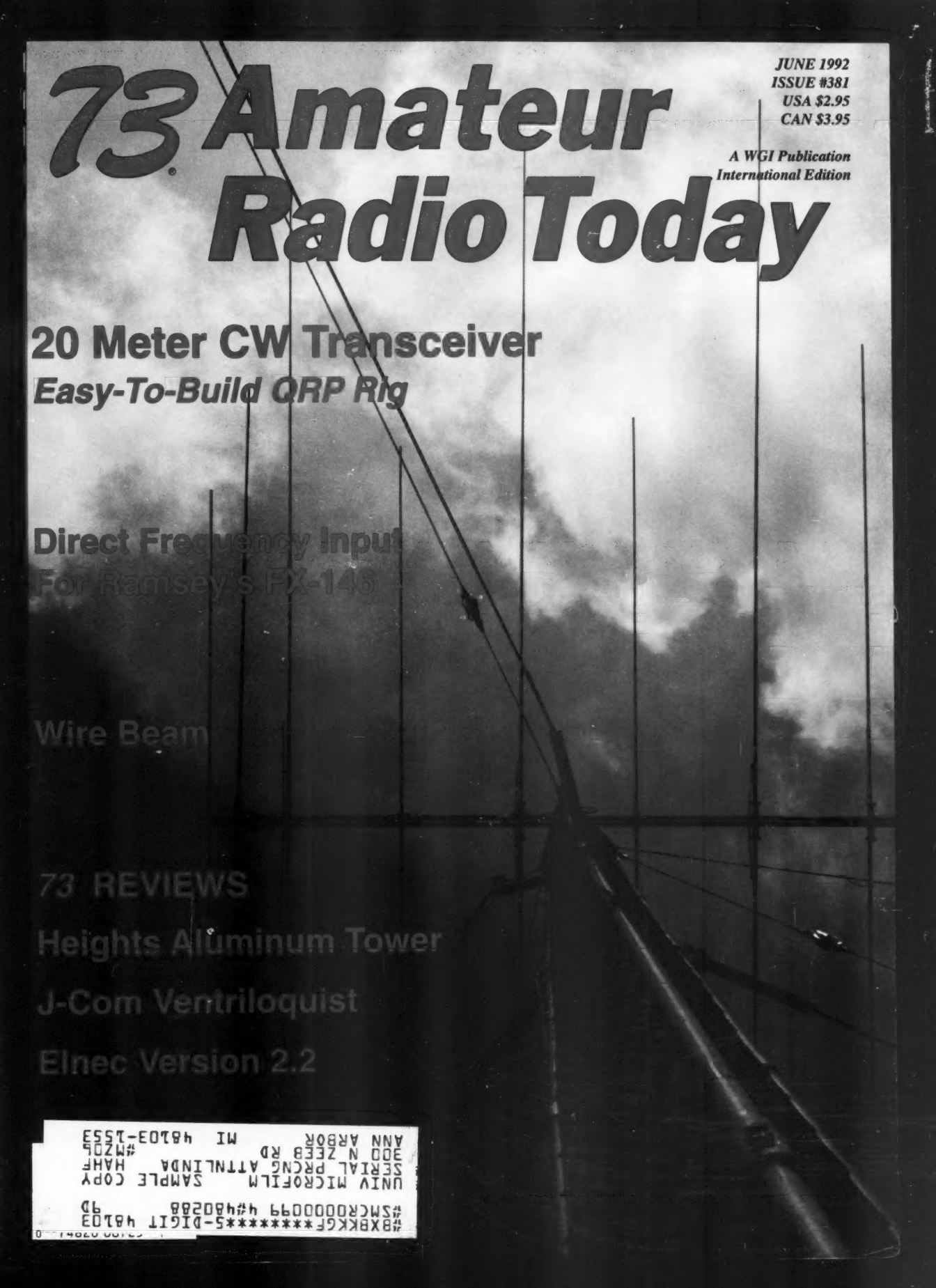

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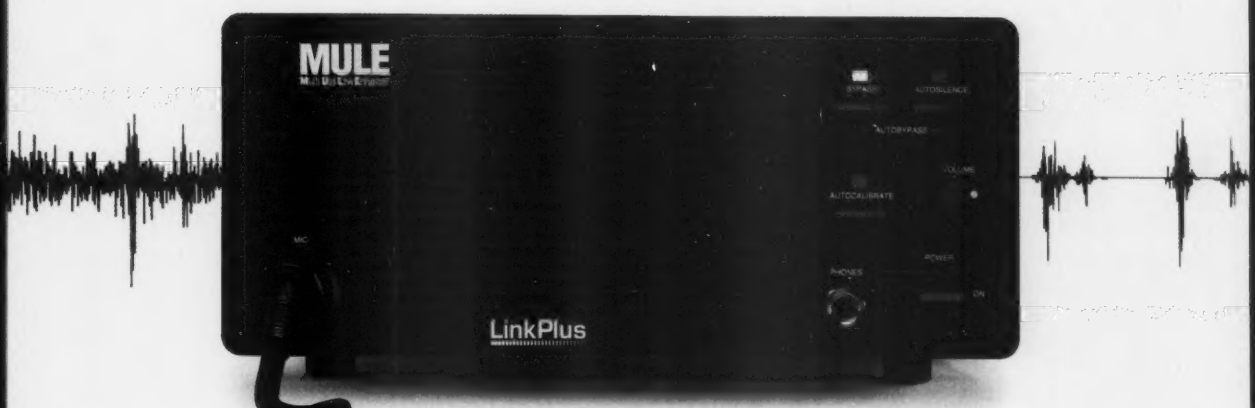

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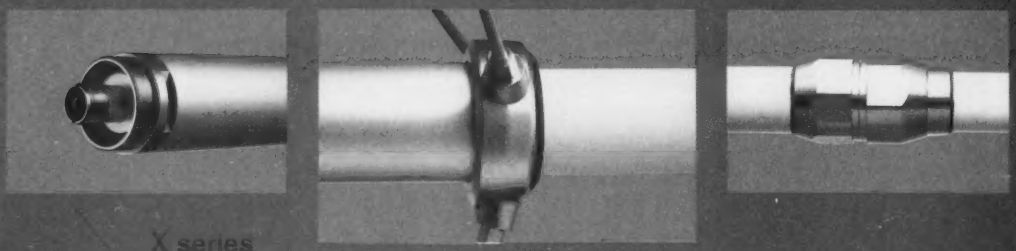

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X-200A	2m/70cm	6.0/8.0	200	8.3	UHF	112.5	2m:2-5/8λ,70cm:4-5/8λ
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U-5000A	2m/70cm /23cm	4.5/8.3 /11.7	150	6.0	N	135	2m:6/8λ,70cm:3-5/8λ, 23cm:7-5/8λ

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F-23A	2m	7.8	200	15.0	UHF	90	3-5/8λ
F-142A	1 1/4m	5.5	200	6.0	UHF	110	2-5/8λ
F-718A	70cm	11.5	250	15.0	N	90	18-1/2λ
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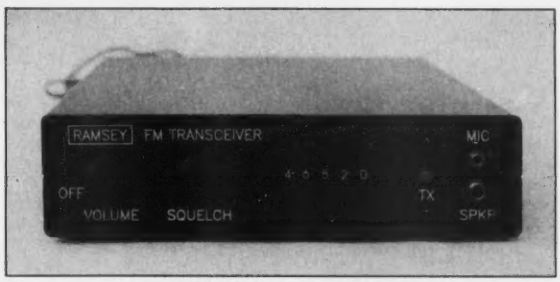

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PUBLISHER/EDITOR
Wayne Green W2NSD/1
ASSOCIATE PUBLISHER
David Cassidy N1GPH

MANAGING EDITOR
Bill Brown WB8ELK
PRODUCTION EDITOR
Hope Currier
EDITORIAL ASSOCIATES
Sue Jewell
Joyce Sawtelle
CONTRIBUTING EDITORS
Mike Bryce WB8VGE
David Cowhig WA1LBP
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Arnie Johnson N1BAC
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP

ADVERTISING SALES REPRESENTATIVES
Dan Harper
Louise O'Sullivan
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Editorial Offices
70 Route 202N
Peterborough, NH 03458
603-924-0058, FAX (603) 924-8613
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Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

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70 Route 202N
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phone: 800-274-7373

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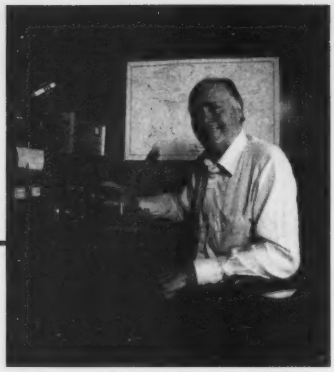
Contract: Are you in an amateur radio rut? By reading this small print, you have become legally obligated to Uncle Wayne and his Team to try something new. Build a QRP rig, help a newcomer, experiment with microwaves, build a tuner and load up the neighbors' fence, operate from a mountaintop—try something different.



NEVER SAY DIE

Wayne Green W2NSD/1

Good News—Bad News

The news, good and bad, is that Wayne Green again owns *73 Magazine*. Well, you probably weren't even aware that I haven't owned it for almost 10 years, so never mind.

When I sold my seven computer magazines and other stuff in 1983 I also had to sell *73* at the same time because I was left with no publishing company with which to publish it. So IDG took over the publication while I started from scratch to build a new publishing company.

There was a big sigh of relief by IDG when Wayne and his long, controversial editorials were finally out of the magazine . . . now circulation would grow and advertising sales would zoom. Instead, despite every effort, the circulation dropped off disastrously and ad sales dwindled.

Just as the death rattles were beginning to be heard, IDG gave up and talked me into publishing it again . . . on contract. They retained ownership and a share of the profits. Profits? From a magazine that I'd managed to lose money on for over 20 years? Har-de-har.

Like all entrepreneurs, my interest was never in making money, so whenever there seemed like a danger of a profit I'd start a new project and take care of the problem. *73* always lost a little money, but never enough to put it out of business . . . and the other projects always made enough to keep *73* going. Nothing has changed. I publish *73* because I think it's needed . . . and ham radio is still my #1 hobby, even after over 50 years.

So here I am 32 years after starting the magazine, again the owner, and still losing a little money with it. IDG wanted to buy my *CD Review* magazine, so as part of the deal I got *73* back. I have no idea why they wanted to buy my music magazine . . . I'm not even convinced they'll be able to run it successfully. But after eight years it was mature and I much prefer to do new things . . . like *Radio Fun*. I enjoy starting new publications.

With the sale of *CD Review* I'm down to just a few publications . . . *73*, *Radio Fun*, *Secret Guide*, *Music Retailing*, *IMPS Journal*, *NIAC* newsletter, a recording studio, a music distribution company, a mail order music company, and five record companies. Time hangs heavy on my idle hands.

Of course I do have several new publications being gestated. My idle hands are the devil's playground. And I've been generating a storm of plans for bringing New Hampshire into the 21st century ahead of the other states . . . with a complete revamping of our educational system among other things. Some of our 73-BBS customers have dumped my 300-page book on the subject.

The change of ownership won't change *73*. It's being run almost totally by Bill WB8ELK and Dave N1GPH, with me writing editorials now and then.

Well, I thought you might like to know.

Homosexual Hams

There are probably some red-faced hams out there who were furious with me for running ads last year for a homosexual ham club. They were firmly convinced that homosexuality is catching—like communism—and that therefore youngsters shouldn't be exposed to it. I explained in my editorial that it's genetic, so not to worry that their impressionable children would be lured into homosexual liasons once they knew there was a homo ham club.

I became aware of this as a result of my professional psychological work with several homosexual patients. It is not something which is curable—at least not yet. It's always possible that scientists may come up with some genetic engineering which could make everyone hetero.

A number of news magazines have reported on recent scientific research which shows that one's sexuality is born, not bred. This confirms the work I did when I regressed homosexual patients and found they were aware of their feelings even when they were one and two years old.

Frankly, I was disappointed to find that homosexuality was genetic. I'd hoped to find it a nurture problem, in which case I might be able to help people with this "problem" through therapy.

Well, I can't do much about hams who hate or fear homosexuals because of stupidity, but perhaps I can help combat ignorance on the subject and make things a little more comfortable for everyone.

Of course I'm probably off on the wrong foot when I assume that ham homo-phobes read newsmagazines, so perhaps a note in *73* is appropriate. I'm used to finding a lot of Archie Bunker in older hams, so while I may be dismayed by their reactions, I'm not surprised.

If one takes the long view of things, the whole world is gradually intermarrying, so we'll all end up a sort of light brown, with perhaps a slightly yellowish tinge. It'll take a while, but it's inevitable. In the meanwhile we'll all continue to respond to our own inferiority feelings by dumping on others and putting them down. And that's what it's all about. The more the put-downs and name-calling, the stronger are the inferiority feelings being compensated for.

In the meanwhile we'll have our ethnic, religious, and political groups busy killing each other. While I'm sorry to see this happening, I also recognize that it's all part of a basic plan for all life on earth—the survival of the fittest. All life has fundamental built-in programmed instructions to stay alive and recreate one's self.

Nature (God, if you like) is merciless, doing away with failed life forms by the tens of thousands. Mankind, stirred by impassioned environmentalists, often does its best to upset nature and fight God's will, so to speak.

But you know, even with the millions Hitler wiped out, and the tens of millions Stalin and Mao killed, mankind seems to be carrying on. We have no population shortages in sight. Science has moved ahead without missing a step.

Hmmm, I'm waxing philosophical again. Wax and Wayne.

Subliminal Messages

If you read many magazines or newspapers you've seen ads for subliminal tapes which will help you stop smoking, lose weight, be happier and so on. Hmm, one wonders, how many of those ham broadcasters are subliming us?

Can this explain the fierce devotion to the ARRL by thousands of otherwise seemingly unintelligent hams? Have they been subliminally brainwashed while listening to ARRL bulletins? Glenn what's his name in Maine claims thousands of listeners to his endlessly self-promoting broadcasts. Can this explain that weird behavior?

I thought I'd put in that poke at the League to titillate my duuuh readers who are ever-alert to my trashing the ARRL. I enjoy making fun of the League mainly because so many readers take it seriously and get livid. There goes Wayne putting down the League again! You bet . . . and chuckling as I twist the knife.

But isn't it mean for me to tweak hams who've been brainwashed by subliminal messages during the ARRL broadcasts . . . and by all those subliminals in *QST*? After all, it isn't really their fault . . . they didn't mean to get hooked. Isn't it like blaming drug users for their habit?

The obvious answer is yes, and I should be ashamed of myself for so mercilessly taking advantage of subliminally blinded hams . . . hams whose very minds have been taken over by those arch fiends in Newington and their unholy cabal of directors. I ought to recognize that no carrier of the light . . . no whisperer of truths . . . can prevail against their ruthless mind control technology.

You've probably read that people under a hypnotist's control can't be made to do things they wouldn't normally do . . . like kill people or have sex with the hypnotist. And that's what hypnotists want you to believe, though there's not a word of truth in it. Should it count as rape when an evil hypnotist forces a lovely young girl to have sex with him by telling and convincing her how much she wants to?

We're all familiar with how the subconscious works. We all know people who are addicted to cigarettes, alcohol or other drugs and won't consciously admit, even to themselves, that they're addicts. The subconscious works sneakily, but never forget that it's in control, not the conscious mind. It's the force behind the things we do that we don't know why we do. It's the force behind beliefs, no matter how weird. It's the force that makes us angry when a subconscious belief is disturbed. It's the source of all our phobias . . . our fears for which we have no explanation.

No wonder cults . . . enormously powerful cults . . . are based on control of the subconscious. No wonder so many big companies try to reach this key power center with their advertising.

No, you'll never consciously detect these seductive, mind-controlling messages as they are subliminally taking over your subconscious as you listen to W1AW or K1MAN . . . or as you merely glance at the innocent-looking pages of *QST*. We are so used to the messages from Coca Cola, MacDonalds, and other masters of seduction that we consciously feel nothing . . . but perhaps a thirst or a hunger.

So, knowing that tens of thousands of hams have had their minds totally under League control for years, I gently rock the boat and smile as I watch the angry reaction. But which is the real devil? Is it the mind-controlling organization or the tweaker?

Is this a new phenomenon? No, not at all. I first became aware of this secret plot when I read the Doyle Letters . . . letters from an ARRL director to several fellow directors which discussed this and some other plots. Doyle revealed that the president of the ARRL was in the pay of Hallicrafters to see that their equipment always got more space in *QST* than any other, and that the equipment reviews

Continued on page 76

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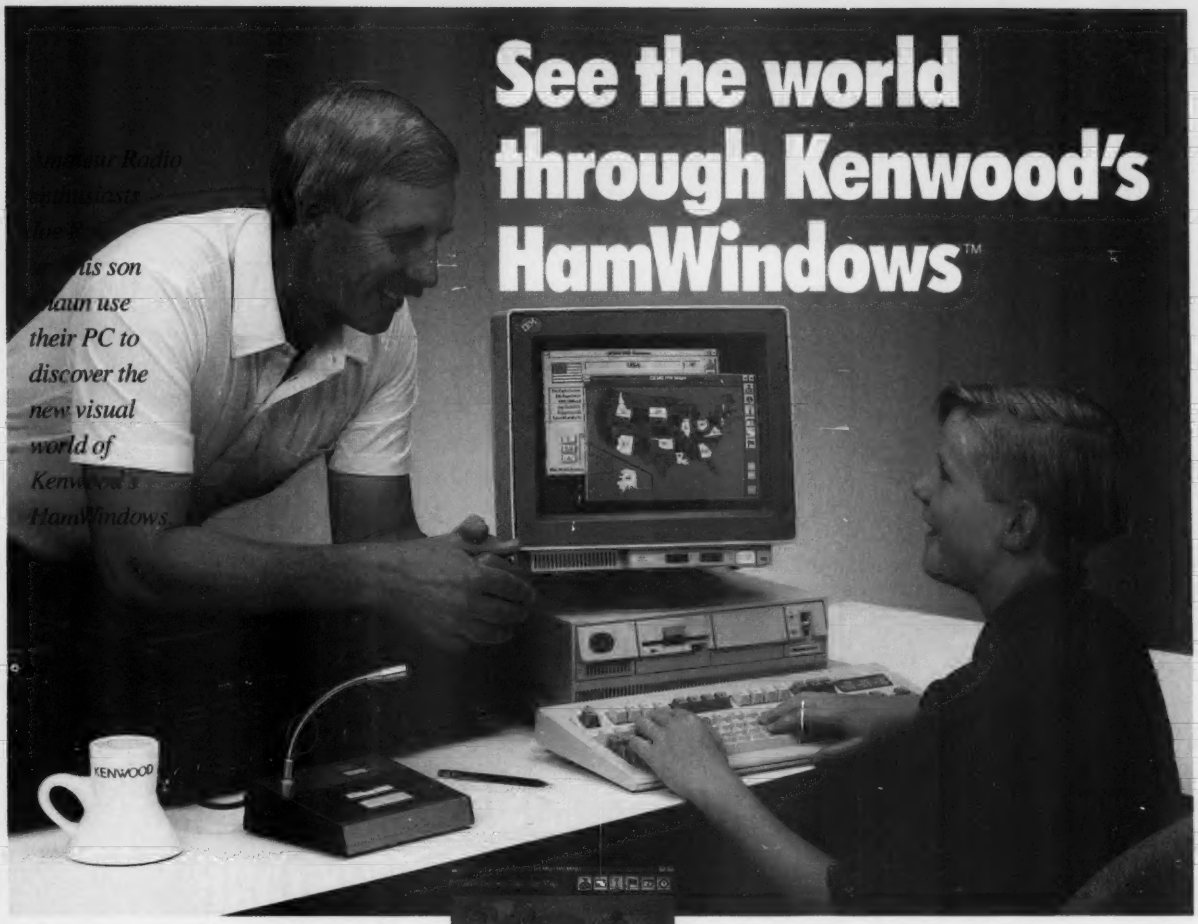

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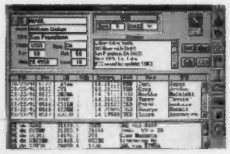

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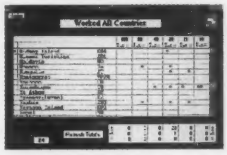

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QRX . . .

Introducing Wayne Green, Inc.

For the past several years, readers have become accustomed to the familiar notation of "A WGE Publication" on the covers of *73 Amateur Radio Today*. As we went to press last month, a deal was reached between Wayne Green and WGE parent company International Data Group whereby full ownership of WGE, including certain properties and assets, was sold to IDG for an undisclosed sum, effectively dissolving WGE.

Part of the deal is that Wayne Green, under the new corporate name of Wayne Green, Inc., has regained full and complete ownership of the rights to *73 Amateur Radio Today*.

While all of this corporate shuffling may be of interest to Wall Street types, the only immediate change for readers, advertisers and distributors is that the editorial and advertising offices have moved, and all phone numbers (except the 800 subscription number, which rings at a subscription company in Colorado) have been changed.

Here's all of the new information:

73 Amateur Radio Today
70 Route 202 North
Peterborough NH 03458

Editorial/Advertising Offices: (603) 924–0058

FAX: (603) 924–9327
Ad Sales: (800) 274–7373
73 BBS: (603) 924–9343

May Cover Contest Winner

When we asked readers to identify what was wrong with our cover photo last month, we had no idea of the volume of mail we would receive. Thousands of letters, postcards and faxes arrived at our offices, most with the correct answer and a few creative incorrect guesses.

One reader thought the mistake was the "A WGI Publication," printed in the upper right-hand corner (see above story). Another reader assumed that the woman was communicating on a marine HT with the boat in the background—the mistake being the violation of regulations that prohibit this exchange.

Many readers thought we made up a prop HT (an ICOM IC-24AT) with the antenna on the wrong side. They were getting warm.

The overwhelming majority of you got the right answer: The photograph was reversed. In order to get the shot we wanted on location and still set up the cover with room on the left for text, it was necessary to shoot the photograph with the woman on the left side, then reverse the photograph so that she would end up on the right side of the page.

Although the HT gave it away, one nautical ham noticed that the running lights on the boat were reversed. One reader said it was "obvious" that we had used two negatives—that the photo of the water and the photo of the woman were two different shots (they were not).

The winner of the one-year subscription is John Huber N8FYL of Troy, Michigan. His was the very first postcard received with the correct answer.

Judging from the reader response, this was a fun little contest. We'll look for an opportunity to do it again in the future, but next time we won't make it so easy.

Indecent Broadcasts

The United States Supreme Court has refused to hear an appeal of a decision of a United States Court of Appeals which held unconstitutional an around-the-clock ban on indecent broadcasts. The high court let stand a May 17, 1991, decision of the U.S. Court of Appeals for the District of Columbia Circuit which held that broadcast material which is indecent but not obscene is protected by the First Amendment, and any restrictions on such broadcasts must be narrowly drawn. The Appeals Court instructed the FCC to determine the times at which indecent materials may be broadcast. In doing so, the FCC must determine the times when there is a reasonable risk that children, who may properly be protected by the government from such broadcasts, are in the broadcast audience.

The decision of a three-judge appeals court panel unanimously concluded that a 24-hour-per-day FCC ban on indecent broadcasts, even though mandated by Congress, was unconstitutional. The Court of Appeals had earlier determined that the FCC must carve out a safe harbor for such broadcasts, but recognized that even constitutionally protected speech can have a strong negative impact on children. Thus, limitations on indecent broadcasts can be imposed, if carefully and narrowly crafted.

The FCC has continued to impose fines on broadcast stations for indecent broadcasts made during the times of day in which children are clearly in the audience. The implications of the court rulings for amateur radio are unclear at present, though the FCC has previously stated that its policies regarding broadcast indecency are equally applicable to amateur radio, noting similarities between the two services. FCC chairman Alfred E. Sikes has recently stated that it is the FCC's intention to enforce its rules concerning indecent broadcasts to the extent permitted by law. ARRL President George S. Wilson III W4OYI was scheduled to be in Washington on March 13 to discuss the matter with FCC Commissioners and Bureau Chiefs, and to urge increased enforcement efforts to resolve what many amateurs believe is a serious problem. *TNX Mike Shy, April 1992.*

Tapes for the Visually Handicapped

Master Publishing, Inc., has granted permission to transfer amateur radio license preparation material authored by Gordon West WB6NOA to audio tapes and/or braille for the visually handicapped. Contact the following agencies for availability:

Volunteer Services for the Visually Handicapped, Inc., 814 W. Wisconsin Ave., Milwaukee WI 53233-2385; (414) 278–3039.

Braille Institute, 741 N. Vermont Ave., Los Angeles CA 90029-3594; (213) 663–1111.

Utah State Library Division, Blind and Physically Handicapped Section, (2150 S. 300 W. #16, Salt Lake UT 85115; (801) 466–5888.

Recording for the Blind, 20 Roszel Road, Princeton NJ 08540; (609) 452–0606.

TNX W5YI Report, Vol. 14, Issue #7, April 1, 1992.

SAREX

W5RRR/S will be the shuttle's call for all future SAREX missions. Two SAREX missions are scheduled to fly this summer: the STS-50 US Microgravity Laboratory and the STS-47 Spacelab Japan mission.

The STS-50 *Columbia* mission will feature the first extended duration orbiter flight, for a record 13 days in space. The mission will carry the United States Microgravity Laboratory (USML) on its first flight. Commander Dick Richards and mission specialist Ellen Baker expressed an interest in SAREX and decided to become hams. They have passed their tests and should get their calls before the launch. On this mission Dick will operate the SAREX-D configuration which flew with the STS-37 crew, including voice, packet, two-way slow-scan, and fast-scan receive modes. To save space the crew will not be using the combination VCR/monitor used on the STS-37 mission. The shuttle's monitors will be used to view video transmission from the ground and video will be recorded on the 8mm camcorder. More importantly, the current SAREX antenna would not work well on STS-50 due to the shuttle's attitude. The USML mission requires a gravity gradient attitude, with the shuttle's tail pointed towards the earth. The dual-band antenna (2m voice/packet/SSTV, 70cm ATV) has been repackaged into a rectangular antenna which fits into an overhead window, similar to the antenna used on the Spacelab 1 and Spacelab 2 missions.

The STS-47 *Endeavor* mission will feature Jay Apt N5QWL, who flew aboard the STS-37 mission, making him the first ham to operate SAREX aboard more than one mission. The mission will include the SAREX-C configuration with packet and voice operations, similar to Ron Parise WA4SIR's STS-35 ASTRO-1 experiments. Many educational contacts are planned, including several with Japanese students. Proposals for pre-planned educational contacts should be sent to the ARRL before June 1st. *TNX Earth News.*

Wanted: Technical Editor

***73 Amateur Radio Today* and *Radio Fun* are looking for a technical editor with a ham license, good knowledge of electronics, and good writing and editing skills.** Send cover letters and resumes (no phone calls, please) to: David Cassidy, Associate Publisher, *73 Amateur Radio Today*, 70 Route 202 North, Peterborough NH 03458.

TNX . . .

. . . to all our contributors! You can reach us by phone at (603) 924–0058, or by mail at *73 Magazine*, Route 202 North, Peterborough NH 03458. Or get in touch with us on CompuServe ppn 70310,775; MCI Mail "WGEPUB"; or the 73 BBS at (603) 924–9343 (300–2400 bps), 8 data bits, no parity, one stop bit. News items that don't make it into *73* are often put in our other monthly publication, *Radio Fun*. You can also send news items by FAX at (603) 924–9327.

LETTERS

Number 3 on your Feedback

From the Hamshack

Dave KD8VI, Lakewood OH I just had to dash off a response to reader Bill Ewald's letter appearing in the February 1992 issue of *73*. It gave me a good chuckle. I couldn't think of anything more out of phase with how I regard your editorials. Hell, I'd gladly pay the subscription price for your editorials alone. The rest of the magazine is a bonus.

I do wish, however, that you'd somehow find the time to write some in-depth historical articles which would detail things such as the "incentive licensing debacle" and some of the other noteworthy topics you sometimes allude to in your editorials. I'd like to hear more on L. Ron Hubbard, and on why the ARRL is our sole national representative and how it got to be that way. I'll bet your perspective would bring the light of truth to these subjects like no one else's.

Keep up the great motivational writing, Wayne. You can't possibly realize how your monthly manifestoes have helped me. That callsign after my name is but the smallest part of the effect they've had.

Marion D. Kitchens K4GOK, Oakton VA Just a note to let you know I enjoy your "Never Say Die" editorials. They are thought-provoking and informative, and at times they are funny too. I enjoyed your reply to a criticism, when you said the editorials were aimed at those with at least two-digit IQs!

While I don't agree with 100% of your ideas (after all, no one is perfect!), I do agree with about 99% of your thoughts. This country needs more people like you with open, energized minds, people who are willing to get up off their duffs and simply do a good day's work.

Gene Roban, Minneapolis MN Wayne, please tolerate my bending your ear for a couple of minutes while I talk about my son, Philip NØETX. When he was 10 he bought a Grundig Mickey-Boy portable for $2 at a yard sale. Two years later he was NØETX. He is now 22, is at the highest amateur license level, and is a junior at the University of Minnesota, where he is enrolled in the Institute of Technology Honors Program. In June 1993 he will receive two degrees, one in physics and one in chemistry. He has a 3.6 GPA.

Despite these achievements, he has never been recognized as a scholar by anyone other than his teachers and his relatives. He has never received one cent in scholarship money. I think it's because we as a society have redefined the word "scholarship" to mean "Let's give the kid some money—he's poor." That is where 95% of all scholarship money goes today, regardless of the student's academic achievements.

My wife and I work very hard to pay for his education because we don't want him to be up to his ass in government loans on graduation day. There are, without doubt, other kids as dedicated as Phil who drop out because of the financial burden.

Let's work hard to put the scholar back into scholarship! Let's find out who the go-getters are and reward them the way we reward the kids who can swish a 25-foot jump shot or throw a football 60 yards. I'd like to see the high schools give a letter in math or science fair participation, or ham radio. These kids need recognition and prestige as much as anyone else. We should think about what they will give back to us.

Lawrence K. Herbert NL7U, Deltona FL I enjoy reading *73 Magazine* and hope that you will keep up the good work. In this section of your magazine I usually read about electronics dealers who have been exceptionally good for the cause of ham radio and are generally all around good guys, but I feel that amateurs need to know about dealers who may treat you less than fairly.

Wayne, your magazine is always touting that hams do more "policing of their own." How about starting a column in *73* that would be a consumer advocate for hams? Other publications do this with more than just a little success, as business people who want even more business are anxious to have their good customer relations broadcast as far as possible. Those who are out only for a quick buck also deserve the same. With the weight of *73* behind such an effort, I'm sure the results for those who need such a service would be good.

Carl Hattan KØBZV, Melbourne FL After reading your "Never Say Die" column in the February issue of *73*, I felt I should really drop you a personal note.

I have been a *73* reader for over 30 years. I remember when the magazine was a lot smaller and I would buy it, at the time, at World Radio Labs in Council Bluffs, Iowa. A lot of the Saturday morning hams who hung out at Leo's place acted as my elmers.

Like you, amateur radio was my ticket in the military to a 20-year career as a communications equipment repairman in the Air Force. I spent 15 months in Vietnam as a forward area maintenance man so someday maybe we will meet and swap a few tales. I can still hear the "Whoosh-Boom" of those incoming rockets!!

As I am writing this, I am waiting for my ride to the airport to get to southern Missouri to pay final respects to my mother. The latest *73* is going as I need something interesting to read to keep my mind off the reason I am traveling. About 12 years ago, *73* made a similar trip so I could pay last respects to a sister. I would like to thank you for helping me over some real rough spots in my life.

I took another page from the "Wayne Green Book of Life" also. I knocked off the cigarettes and beer and got back into ham radio with something besides a 2 meter handheld. The radios and most of my will to do anything went with a bankruptcy a few years ago. After sitting around feeling sorry for a while, I got my hands on an old Heath HW-16, fixed it up, and am now having the time of my life working CW with homebuilt keyers, homebuilt paddles, and homebuilt antennas. The motivation for this came from the pages of *73*. My six-year-old daughter is rapidly learning the code and enjoys being able to "talk" without Mommy having the slightest idea of what's going on. Maybe the XYL will get hooked, even if in self-defense. I am working with a young man down the street who likes the idea of ham radio. We chop up a whole lot of PVC pipe and wire and, in general, have a lot of fun with antennas.

What I am trying to say, Wayne, is that you are right when you say, "Get off your lazy butt and do something!!" I found that amateur radio is a lot better therapy and cheaper than doctors. A hundred bucks (one hour with a shrink) can buy a lot of wire, parts, pipe and other stuff and I have something to show for it afterwards. Although I work CW, I am not one of the old "CW forever"crowd. Whatever it takes to get these young people into the hobby should be done. Having had a whack at about all the modes of ham radio, I decided that QRP was an interesting thing and I am busy building little transmitters, receivers, and antennas as well as taking receivers to schools and the day care center to monitor the space shuttle during the missions. I am extremely fortunate to have an employer who will let me do this without too much grumbling.

I have heard and read about you being a "rabble-rouser" and "instigator."If the benefits I am getting from the hobby are any indication, I am proud to be counted among "Green's Rabble."I have found that you are never too old to have a whack at something. Who knows, you might like it! A lot of my dreams have have been dusted off and revived. When my father goes to his final reward, please be around so *73* can make that trip with me too. Be careful what you say or write; somebody might pay attention!!

Thanks for a lot of years of fun and I hope we will enjoy a lot more.

Ken Uthus KT7E, Nine Mile Falls WA Last night I read your February *73* editorial (plus reviewing January) and they left me with a few questions. Are you sincere when you say that we hams can pull ourselves out of the slime pit that we have built and live in? I see us as a bunch of alcoholics who have not yet reached the bottom of decline so we can't see the threat to our bands. We are striking out (like our mediocre president and his entourage of mediocrity to Japan) at the wrong enemy, who you well know is us. It seems to me that we will have to suffer some irreversible loss of bands before we wake up. Hams, industry and the country are without leadership. Emperor George Bush wants to be the Ruler of the New World Order and lacks interest in the U.S. so the country lacks the stimulus a leader provides. The aspirations of the ARRL president are beyond my reasoning so I have no sense of the direction if any that the league might be suggesting. Industry heads are into self promotion first and company performance second. Congress? Who knows what they might do next.

The parallels between our country and my recent readings of history telling me about the rise and fall of great powers frighten me. We are on the path to self destruction those other powers followed. Our country flared into a super nova during WWII before we were ready for the leadership role, bringing up the wrong people, from which we have never recovered. The bright star that was ham radio became a super nova on December 7, 1941, to be replaced with Operator Radio in 1946. A bunch of ex-military radios ops got their tickets and got on the air with surplus radio equipment and the exchange of handie, QTH, rig and WX began. Even then a rag-chew was tough to come by. We became a black hole in the late '50s—early '60s, along the same path of our country (the demise of the big bands accompanied us).

I don't mean to imply that nothing worthwhile came out of the "surplus era." I learned a lot using cheap surplus magnetrons, klystrons, 3' dishes, UHF receivers and the like. Three of us had contacts on a 500'-long path at 3 GHz (more or less) with that surplus equipment. We used gold-plated diode detectors (1N21?), klystron local oscillators, UHF receivers for IF and CW magnetron and modulated klystron transmitters. We earned credit in 1947 toward an engineering degree for that effort. However, surplus equipment was the beginning of radio kits. It was so simple to modify an ART 13 for a quick 500-watt CW rig and 50 watts of AM, so why bother to build from scratch? Surplus provided cheap "kit" construction and that ended scratch construction in general.

Maybe I'm too cynical but I can't see any hope for ham radio. It seems to me that we have the "right" to our frequencies if we have something to contribute. At one time we made big contributions to the art of radio. At one time we made big contributions to emergency traffic. When was our last contribution to the state of the art? How much assistance do we really provide to emergency communications? Oh sure, we are great when it comes to assisting at parades and other scheduled social events, but when the Red Cross or other emergency body needs help, where are we if the call is inconvenient to us? The usual dedicated few show up but where are the members of ham clubs?

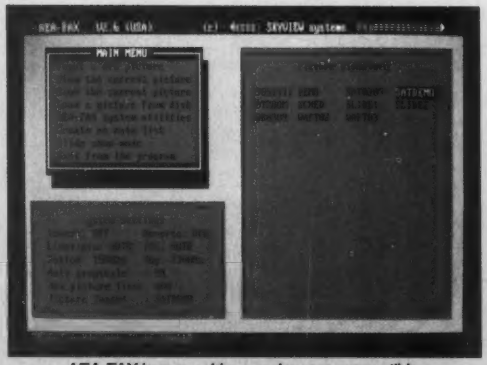
Ma Bell first used SSB in the mid '30s and started conversion to digital in the '60s, about the time we hams were getting into SSB. Who said we are slow to pick up new technology? When I was first into ham radio in the late '30s, I remember a couple of hams who worked for Ma Bell demonstrating DSBSC and discussing SSB. If WWII hadn't come along, we just might have been into SSB 20 years sooner than we were because we had the experimenters at that time. Where did they go? Nothing short of a drastic reduction in band allocations will prompt us off our gibbering butts to bandwidth-efficient digital systems. Like the rest of the country we are market-driven and gave up development long ago. So when the market makes digital available, we will merrily jump to the market tune by necessity because we won't have the fat in our bands to feed our glutinous FM and SSB frequency hogs.

Next question: Do you believe the FCC will approve TDM or some other digital system for hams? My limited experience with TDM suggests that it is really easy to encode traffic which is a no-no to the great regulator.

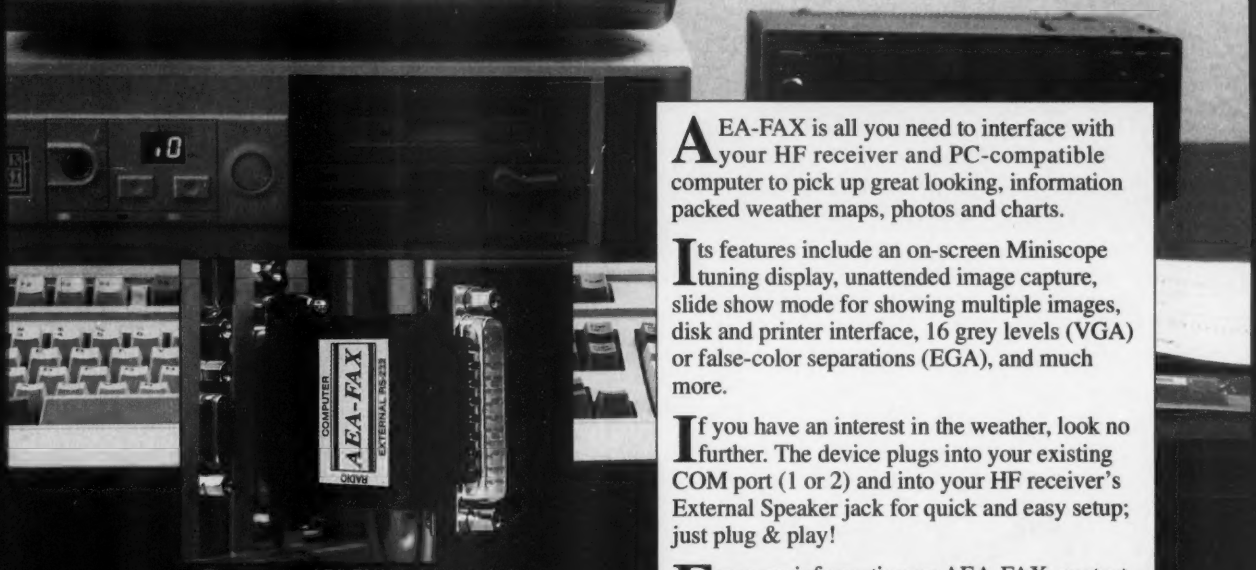
I admire you for your "Never Say Die" pep talks because we badly need someone in the editorial world who is seeing what is happening to us plus has the guts to tell us how it really is. Here comes the "but" part: But we don't have a prayer of saving all of our bandwidth. We don't deserve our frequencies. However, the marketing forces will protect us from ourselves with appropriate lobbying, hopefully, until we can get digital on the air if we can get the approval. But even the big boys can't save all of our precious real estate.

Keep pushing. You just might get the OK and get some digital experimenters on the air and then we'll be off and running. 73

Weather FAX



AEA-FAX is menu-driven and mouse compatible for ease of use.



The compact AEA-FAX hardware includes a daisy-chain RS-232 input.

AEA-FAX is all you need to interface with your HF receiver and PC-compatible computer to pick up great looking, information packed weather maps, photos and charts.

Its features include an on-screen Miniscope tuning display, unattended image capture, slide show mode for showing multiple images, disk and printer interface, 16 grey levels (VGA) or false-color separations (EGA), and much more.

If you have an interest in the weather, look no further. The device plugs into your existing COM port (1 or 2) and into your HF receiver's External Speaker jack for quick and easy setup; just plug & play!

For more information on AEA-FAX, contact your favorite ham radio dealer.

To receive a catalog of our complete product line, call toll free (800)432-8873.

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P.O. Box C2160 / Lynnwood, WA 98036-0918
Customer Service (206)775-7373, Upgrade Hot Line (206)774-1722
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8,000 Channels for the Ramsey FX-146

Add direct frequency input to this popular 2 meter transceiver kit.

by Cecil A. Moore KG7BK

The Ramsey FX-146 is a good little 2 meter transceiver. It has reasonable sensitivity and selectivity, and outputs 5 watts. It covers 140–180 MHz in five kHz steps. That's a whopping 8,000 channels for $150! Unfortunately, it only has 12 channel positions on the selection switch. This article describes how to access all 8,000 frequencies (140–160 MHz) for about $25 worth of parts.

I previously applied this technique to my ICOM-22S to obtain 720 channels.

Thumbwheel Frequency Selection

The FX-146 is normally programmed by soldering diodes into a binary matrix that is 16 bits wide. Two EPROMs can completely eliminate the primary selection diodes and the selection switch. An EPROM (Erasable Programmable Read Only Memory) can be thought of as a large diode matrix at a cost of around 0.01 cents per diode. A

Photo A. Modified front panel of the Ramsey FX-146 2 meter FM transceiver showing the thumbwheel frequency switches.

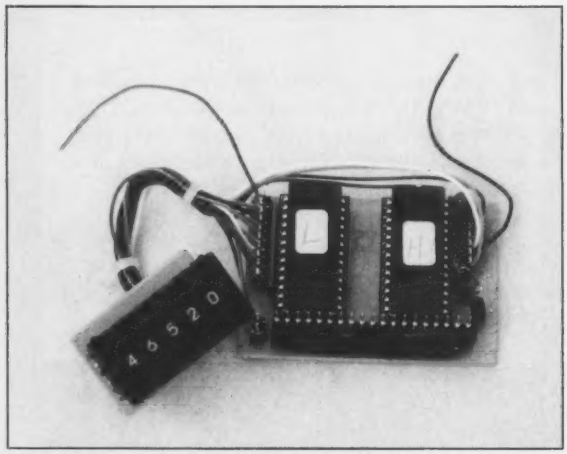

Photo B. The completed EPROM board and thumbwheel switch assemblies. Note the 19-pin header which allows the circuit to plug in directly to the FX-146 PC board.

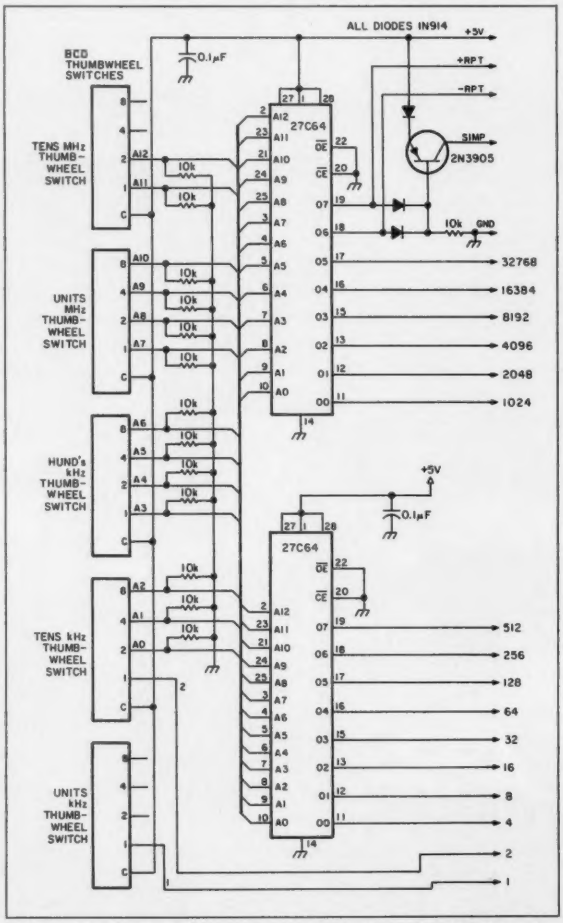

Figure 1. Schematic diagram for the 8000-channel EPROM board.

MFJ 20 Meter CW Transceiver

. . . throw this *tiny* CW rig in a corner of your briefcase and enjoy DXing and ragchewing wherever you go . . . you get a high performance superhet receiver, crystal filter, RIT, AGC, vernier tuning, sidetone, speaker,up to 5 watts output, semi-break-in, more . . .

MFJ-9020

$179.95

- ***15 Meter and other bands available soon***
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- ***Unconditional Guarantee for one full year***

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You'll turn lonely nights into exciting adventures as you contact fellow amateurs around the world.

20 Meters is open day and night so you can operate whenever you have a free moment.

With 5 watts you'll have plenty of power to work the world even with a makeshift antenna.

At home with a good dipole, vertical or beam, you'll be able to work almost anyone you hear — can you imagine earning DXCC with 5 watts?

Big gun DX'ers: Try a new DX challenge for the price of a simple station accessory.

It's good enough to be your only rig — you get a high performance superhet receiver, razor sharp 8-pole crystal filter, RIT, AGC, vernier tuning, sinewave sidetone, built-in speaker, headphone jack, adjustable semi-break-in, up to 5 watts output plus much more.

Covers lower 20 Meter CW band, 14.000 to 14.075 MHz. 6x6½x2½ inches. Weighs 1-3/4 lb. Uses 12-15 VDC. Optional plug-in Curtis chip keyer, narrow audio filter, antenna tuner, power pack and antenna.

High Performance Superhet Receiver

You get a high performance superhet receiver with a selective double tuned front end and double-balance mixer. It's sensitive enough to copy weak DX signals down to the noise floor yet resist overload when a strong local comes on.

What you hear is what you get — images and birdies are eliminated with this single conversion design and a high 10 MHz IF.

A ball bearing reduction drive and linear frequency readout gives you smooth precise tuning.

Half watt of audio gives you plenty of volume from headphones and built-in speaker.

Razor Sharp Selectivity

You'll slice through QRM and pull weak ones out of the mud with an 8-pole crystal filter that gives you razor sharp selectivity with steep sided skirts.

Instant Recovery AGC Circuit™

Weak DX signals are just as loud as strong local ones because the MFJ-9020 *graceful* Automatic Gain Control (AGC) keeps your audio level constant.

You get smooth break-in operation because MFJ's exclusive *Instant Recovery AGC Circuit™* gives you *instantaneous* transmit recovery.

True Receiver Incremental Tuning (RIT)

True Receiver Incremental Tuning (RIT) lets you dodge QRM and compensate for other's drift without moving your transmit frequency.

MFJ *Integrated* CW Station

Transceiver, tuner, power pack* fastens together *to form tiny 6x6½x8½ inch integrated CW station.

SAVE $40

MFJ-9120B

$329.80

Save $40! $329.80 buys complete MFJ CW Station. Includes MFJ-9020 transceiver, MFJ-971 tuner, MFJ-4114 power pack, MFJ-1760 antenna . . . order MFJ-9120B. $369.80 if purchased separately (keyer and filter not included.)

Enough Power to Work the World

With 5 watts you'll have plenty of power to work the world even with a makeshift antenna.

You can use any antenna with an SWR up to 3:1. The MFJ-9020 is rugged enough to withstand momentary antenna opens or shorts without damage.

If you're really into QRP you can reduce your power down to milliwatts.

A pleasing *sinewave* sidetone lets you monitor your sending.

You also get quiet adjustable semi-break-in and adjustable automatic transmit offset.

You'll get hours of battery operation — draws only 50 ma. receive, 1 amp transmit.

Looks Great!

The MFJ-9020 is housed in an attractive matte-black aluminum enclosure with a deluxe brushed-aluminum front panel and matched knob set. Machine screws and pressed-in PEM nuts are used — not sheet metal screws.

Has power-on LED, transmit LED and SO-239 coax connector for antenna.

Designed by Rick Littlefield, K1BQT

The MFJ-9020 was designed by Rick Littlefield, K1BQT. He's known worldwide for his reliable high-performance transceiver designs and countless articles.

K1BQT has given careful attention to board layout, heatsinking, mechanical rigidity, voltage regulation and component selection to ensure stable operation and long-term reliability.

It meets or exceeds all FCC requirements.

Comes fully assembled, tested and guaranteed to work

Your factory built MFJ-9020 is ready to work DX right out of the box. It's not a kit of parts you have to put together and hope you can get to work.

Free MFJ-9020 Manual

Manual includes operating instructions, setting up your station, DX techniques, antenna suggestions, trouble shooting guide, theory of operation, alignment procedures, parts placement, schematic, parts list and more.

For *free* MFJ-9020 manual write or call MFJ.

Plug-in Keyer and Narrow Filter (Optional)

MFJ-412 Curtis chip iambic keyer, $39.95.

MFJ-726 narrow audio filter, $29.95. Has In/Out switch.

Each plugs into MFJ-9020. Controls on rear panel. No soldering or modifications needed.

No Matter What™ Guarantee

You get MFJ's famous one year *No Matter What™ unconditional* guarantee. That means we will repair or replace your MFJ-9020 (at our option) *no matter what* for a full year.

Continuing Service

MFJ Customer Service Technicians will help you keep your MFJ-9020 performing flawlessly — no matter how long you own it. Just call our toll-free help line 800-647-TECH(8324) — *an MFJ exclusive.*

Made in USA

The MFJ-9020 is made in the USA. Help our fellow Americans by keeping our money here -- buy Made in USA.

Call Your Favorite Dealer Today

Enjoy DXing and ragchewing wherever you go. Call your favorite dealer today and get your MFJ-9020. Don't leave home without it!

Other Bands Available Soon

MFJ CW Transceivers for 15 Meters and other bands available soon. Watch for them.

MFJ *Portable* Operating Accessories

MFJ *Portable* Antenna Tuner

MFJ-971 **$89.95**

Has Cross-Needle SWR/Wattmeter, covers 1.8-30 MHz, balun for balanced lines, 200 watts PEP. Tunes coax, balanced lines, random wire. Wattmeter has two switchable ranges: 30, 300 or user selectable 6 watt ranges. Tiny 6x6½x2½ inches matches MFJ-9020. Fastens to MFJ-9020 and/or MFJ-4112 Power Pack to form single unit.

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MFJ-4112 **$59.95**

Portable Battery/AC Power Pack for MFJ-9020 or other low power transceiver. Provides 12 VDC from eight D cells (not included) or from 110 VAC. 6x6½x2½ inches matches MFJ-9020. Fastens to MFJ-9020, MFJ-971. **MFJ-4114, $69.95**. Same as MFJ-4112 but includes charging circuit for Ni-cad D cells (not included). 6x6½x3½ inches.

MFJ *Portable* Antenna

MFJ-1760 **$29.95**

Efficient 20 Meter dipole. Lightweight, easy to carry, easy to put up. Perfect for portable operation with MFJ-9020.

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binary address is input to the device and binary data comes out. The 27xxx series of EPROMS are very popular in microcomputer applications. An address is input and eight data bits are output. The larger the memory, the more address bits are required.

All 8000 channels (40 MHz/5 kHz = 8,000) can be accessed in the FX-146 using two 27C64 EPROMs (cost around $6 each) and five inexpensive BCD (Binary Coded Decimal) thumbwheel switches available for about $2 each on the surplus market. The Cherry T59-02M, available from the Newark catalog, is a perfect fit but costs $5.50 per digit. The five thumbwheel switches are used to enter the frequency in decimal. Thus, for 146.520 MHz, 4, 6, 5, 2, 0 would be dialed into the thumbwheels. The EPROMs accomplish the translation from the thumbwheel BCD frequency information to the binary number required by the FX-146.

The resolution of the FX-146 is 5 kHz. Therefore, the units-of-kHz (if the thumbwheel or toggle switch) selection is only one bit, i.e. binary (0 = zero or 1 = five), and is routed directly to the FX-146 selection logic without being translated by the EPROMs. The same thing happens to the LSB (least significant bit) of the tens-of-kHz switch. The rest of the bits coming from the thumbwheel switches are BCD and require a translation from BCD to binary. This design requires BCD thumbwheels; do not use any other type. Be sure to leave the 100k pull-down resistors, R71-R89, installed in the diode matrix area.

The simplex transmit information requires 14 bits from the EPROMs. The other two bits are programmed with transmit offset information. One bit is used for the −600 kHz offset and the other bit for the +600 kHz offset. Figure 1 shows the schematic of the circuit. The offset matrix is programmed as usual with the diodes as shown on the schematic except that the aux split diodes may be eliminated. The two high-order bits from the EPROMs determine whether there is a transmit offset or not. If there is no transmit offset then the transistor circuit automatically generates the simplex transmit signal.

Interfacing with the FX-146

The printed circuit board is designed to align with the diode matrix cathode holes in the FX-146 PC board. Vertical solid wires can be used to mount the EPROM board piggy-back to the FX-146 mother board. To

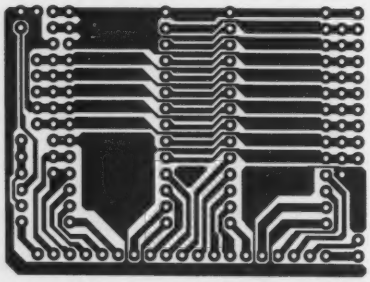

Figure 2. PC board foil pattern for the EPROM board.

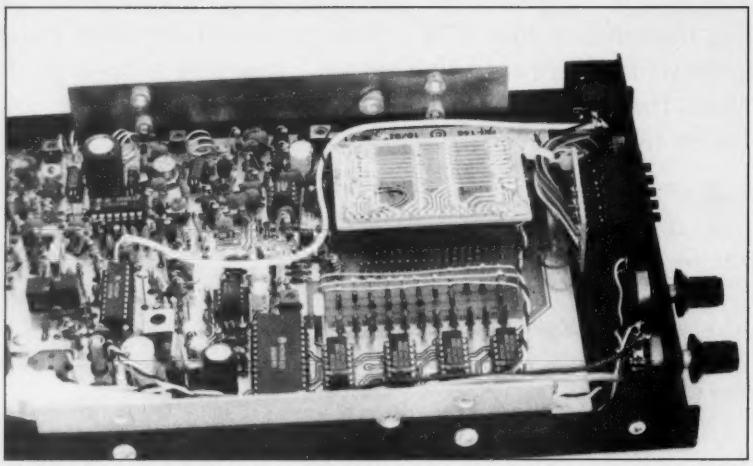

Photo C. Inside view showing the new EPROM board attached to the diode matrix area of the Ramsey FX-146.

Program to Determine EPROM Frequency Select Data

```
10 FOR N% = 7000 TO 9000
20 F = (20*N%)
30 FF=(F-140000!)/10:FFF%=FF
40 UFF%=FFF% MOD 10:FFF%=FFF% \10
50 TFF%=FFF% MOD 10:FFF%=FFF% \10
60 HFF%=FFF% MOD 10:FFF%=FFF%  \10
70 ADR%=UFF% 2+TFF%*8+HFF%*128+FFF%*2048
80 PLDATA%=N% MOD 256
90 PHDATA%=N% 256
100 IF F>=145100! THEN IF F<145500! THEN PHDATA%=PHDATA%+64
110 IF F>=146600! THEN IF F<147000! THEN PHDATA%=PHDATA%+64
120 IF F>=147000! THEN IF F<147400! THEN PHDATA%=PHDATA%+128
130 PRINT "FREQ", "NUMBER", "EPROM ADR", "HIGH BYTE", "LOW BYTE"
140 PRINT F,N%*4,HEX$(ADR%)"H",HEX$(PHDATA%)"H",HEX$(PLDATA%)"H":PRINT
150 IF INKEY$=" THEN GOTO 150
160 NEXT N%
170 END
```

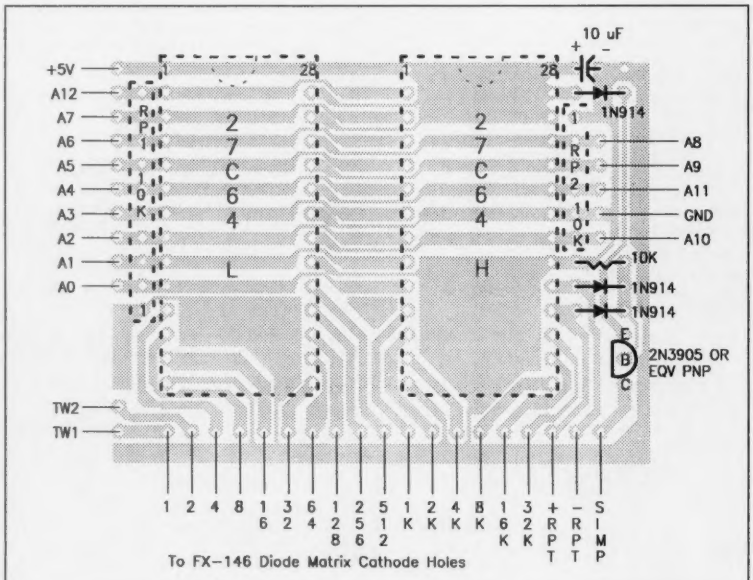

Figure 3. Parts placement for the EPROM board.

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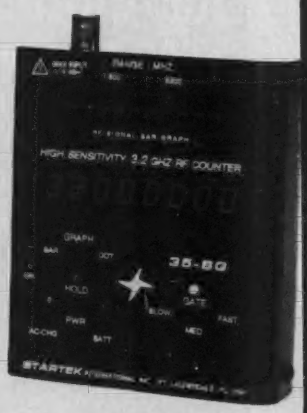

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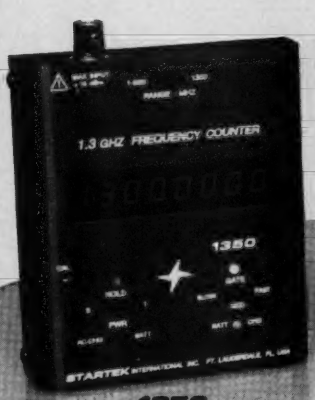

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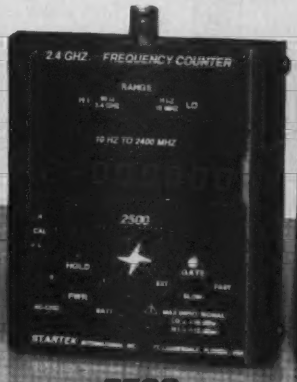

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make it easier to remove, you can mount a 19-pin SIP (Single Inline Package) socket directly to the FX-146 board and attach a 19-pin header to the EPROM board. If you use individual header pins, you can line them up by sticking them in the SIP socket and lining them up with the holes on the EPROM board. Then just solder the pins in place.

You can use a 20-pin socket and header and just cut them down to 19 pins (see the parts list). You'll have to wire the EPROM board up to +5 volts and ground points on the FX-146 board as well.

I attached the 19-pin header to the component side of the EPROM board so it can be plugged directly into the FX-146 board. The foil side of the EPROM board should face up towards you when it's in place (see Photo C).

If you plan to mount the thumbwheel frequency select switches on the front panel just cut out a hole in the panel to allow a snug fit for all five switches. Just run wires from the thumbwheel switches over to the EPROM board as shown in Photo B.

Power up the Ramsey transceiver and you should now have a very versatile 2 meter rig with direct frequency input.

Since the diode matrix area of the FX-146 seems to be relatively free of RF, the board worked well as shown. However, if you should have any problems, you may want to add 0.01 µF ceramic capacitors from each address line to ground.

Programming the EPROMs

How are the contents of the EPROM determined? A BASIC program that yields the data is included in the sidebar. The −600 kHz duplex bit is set for 145.10–145.49 MHz and 146.60–146.99 MHz. The +600 kHz duplex bit is set for 147.00 to 147.39 MHz.

For the faint-of-heart who don't want to

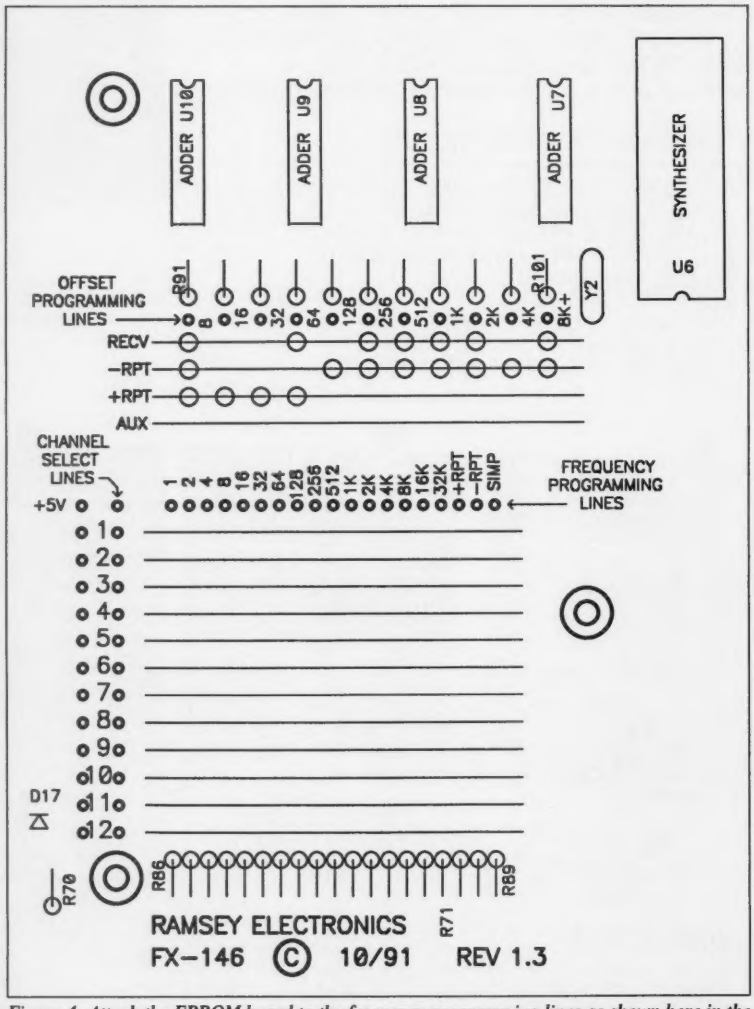

Figure 4. Attach the EPROM board to the frequency programming lines as shown here in the diode matrix area of Ramsey FX-146 PC board. You can either use a SIP socket to mount the EPROM board just above the FX-146 circuit or run wires from the EPROM board to the points shown here. +5 volts and ground are easily obtained from the Ramsey board as well. Diagram courtesy of Ramsey Electronics.

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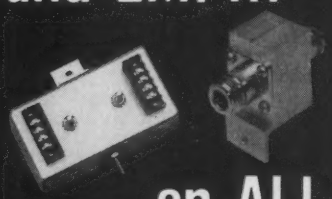

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roll his/her own EPROMs and PCBs, preprogrammed EPROMs, the PC board and a complete set of instructions are available for $39.95 plus $2.00 shipping and handling from DH Consulting, 1803 Mission St., Suite 308, Santa Cruz CA 95060.

The BASIC program for obtaining the HEX address and HEX memory contents for the two EPROMs is listed in the sidebar on the previous page. 73

Contact Cecil A. Moore KG7BK at 18534 E. Via de Palmas, Higley AZ 85236.

Modification for Blind Hams

The BCD thumbwheel switches can be replaced with toggle switches arranged in a BCD pattern that is easy to learn. For instance, to switch in 146.520, the switches would be in the following pattern:

4	6	5	2	0
00	0110	0101	0010	0

A "0" is off and a "1" is on and represents the identical pattern that results from the thumbwheel switches. A total of fifteen toggle switches are required to match the thumbwheel outputs. However, if only amateur band coverage is required, the first three switches can be omitted. If 10 kHz spacing is adequate, then the rightmost switch can be eliminated, resulting in a total of just 11 toggle switches.

Parts List

Qty.	Description
2	27C64 EPROM
2	24-pin standard DIP IC sockets
1	10 µF tantalum capacitor (Newark #87F5118)
3	1N914 diodes
1	10k resistor SIP pack, 6-pin (Newark #81F9597)
1	10k resistor SIP pack, 10-pin (Newark #81F9601)
1	10k, ¼-watt resistor
1	2N3905 PNP transistor or equiv.
5	BCD thumbwheel switches (Newark #90F2080)

The following items are not required, but make the board pluggable:

1	20-pin SIP socket (Newark #89N6182)
20	Pin terminals (Newark #65F1610)

The two programmed EPROMS and a PC board are available for $39.95 plus $2 shipping and handling from DH Consulting, 1803 Mission St., Suite 308, Santa Cruz CA 95060. The SIP components are available from Newark Electronics, 4801 N. Ravenwood Ave., Chicago IL 60640; phone: (312) 784–5100.

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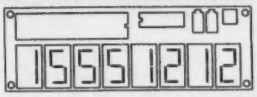

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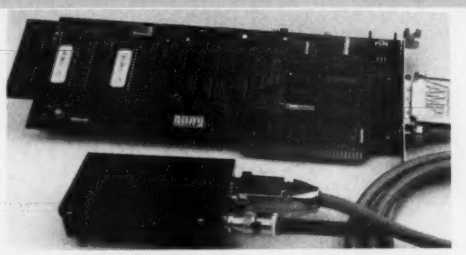

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VE3CYC's Wire Beam

Versatile gain antenna for a limited space.

by John Van der Ryd VE3CYC

Primarily designed for 15 and 20 meters, this beam does a fair job on 12 and 10 meters as well, and also works like a regular dipole on 17 meters.

Some Basic Advice

When building an antenna, keep in mind that there is a considerable difference between bare wire and insulated wire. The actual length of insulated wire must be considerably shorter than bare wire to arrive at the same resonant frequency. The opposite is true if you use bare wire instead of insulated wire—a piece the same length as a piece of insulated wire will give a higher resonant frequency.

We have all noticed how our antennas misbehave when they get wet or are covered with ice. Just watch your SWR meter go up when that happens. This is because the dielectric constant is not the same as it would be if dry air surrounded the bare wire. The purpose of the antenna is to create alternating magnetic and electrostatic fields around itself at the operating frequency. These fields are continuously pushed away into the surrounding space at the speed of light. It is the resistance, created by the material enclosing the wire, which slightly opposes the radiation of these electrostatic fields (resisting the flow of electrons in the antenna.) This means that the antenna has to be shorter to be resonant again at the original frequency. This is a blessing in disguise because, although it has no apparent effect on the propagation of our radio waves, it makes the antenna a little bit smaller.

If you want this antenna project to be successful, follow my instructions to the letter and stick to my dimensions. Before I get involved in the actual beam antenna I will first describe how I made a good working multiband dipole antenna. You might even decide, after reading this part, to make just the multiband dipole instead of the unusual "VE3CYC's Wire Beam."

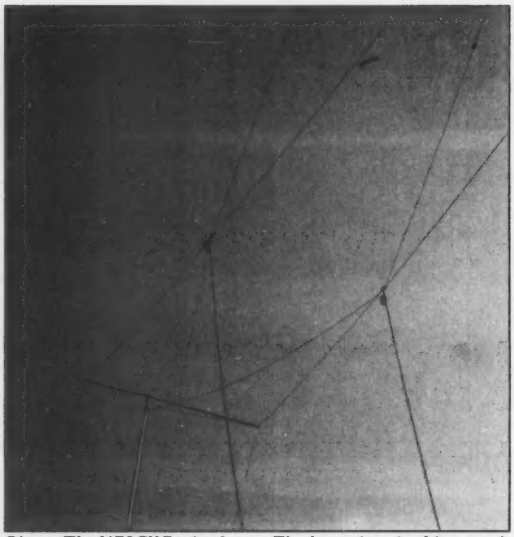


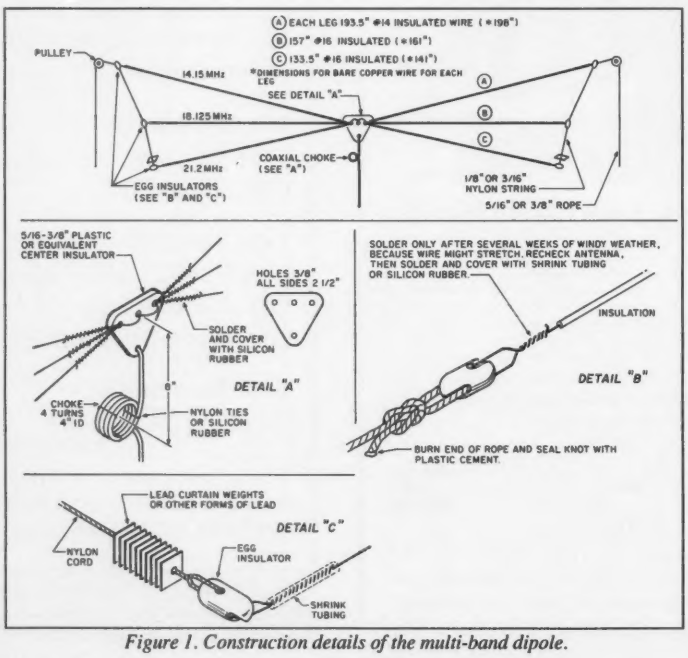
Photo. The VE3CYC wire beam. The beam is raised into position by pulleys and nylon rope supports attached to vertical masts.

I used flexible insulated wire in both the multiband dipole and the multiband beam antenna. The insulation prevents corrosion, while also making the antenna shorter and nicer looking.

How It Got Started

Let me tell you something about the history of my QTH because it led up to this amazingly simple, effective, and handy multiband wire beam antenna. Quite some time ago my better half and I decided to make our QTH a bit more presentable, with the idea of putting it up for sale and buying that "one-acre estate out in the country," which every ham dreams about. The thought of having an antenna farm at my disposal really turned me on—something to do during the Golden Years.

After spending many hours painting, etc., my XYL suggested that I take that ugly beam (a commercial 3-element tribander) down too. She figured that a colossal TV antenna like that would certainly turn prospective home buyers off. So down came the old faithful beam, and I sold it about a year later, realizing it was no good to me laying in our basement gathering dust. After all, once I got that Golden Years QTH, I would have lots of time to build my own monobanders (including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HOLES 3/8" ALL SIDES 2 1/2"
SOLDER AND COVER WITH SILICON RUBBER
DETAIL "A"
CHOKE 4 TURNS 4" ID
NYLON TIES OR SILICON RUBBER
SOLDER ONLY AFTER SEVERAL WEEKS OF WINDY WEATHER, BECAUSE WIRE MIGHT STRETCH. RECHECK ANTENNA, THEN SOLDER AND COVER WITH SHRINK TUBING OR SILICON RUBBER.
INSULATION
DETAIL "B"
BURN END OF ROPE AND SEAL KNOT WITH PLASTIC CEMENT.
LEAD CURTAIN WEIGHTS OR OTHER FORMS OF LEAD
DETAIL "C"
NYLON CORD
EGG INSULATOR
SHRINK TUBING

Figure 1. Construction details of the multi-band dipole.

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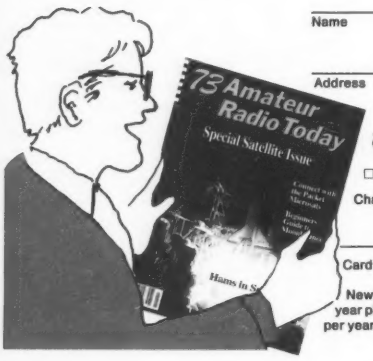

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9 Review: Heights Tower Systems Aluminum Tower
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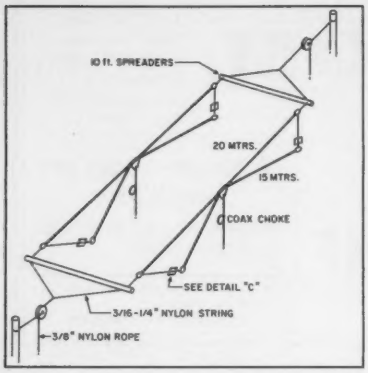

Figure 2. The wire beam for 15 and 20 meters (first version).

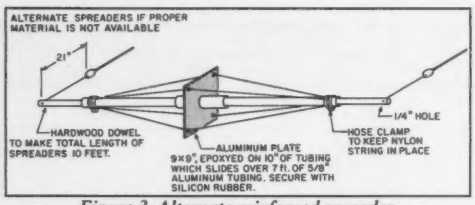
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Figure 3. Alternate reinforced spreader.

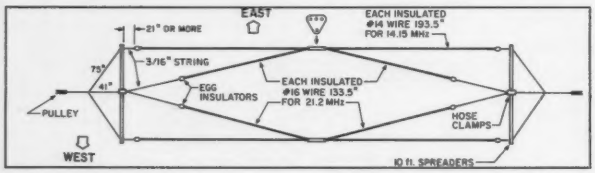

Figure 4. Top view of the improved wire beam. The 15 meter elements now have less tendency to move in high winds.

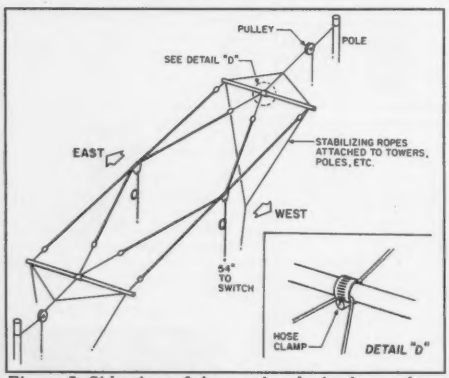

Figure 5. Side view of the two-band wire beam showing attachment points of the stabilizing ropes.

all WARC bands).

Well, to make a long story short, we never did sell the house. And I found myself without a good antenna system except for an all-band vertical that I cooked up a few years ago. I am not knocking verticals—they have their place, but just try to listen to the people you are working while five stations from the side or rear are also coming through equally strong. Not to mention the high atmospheric noise levels coming from the east after nightfall. All of which you can greatly reduce with the use of a good beam antenna.

My First Attempt

Since I already had a 40-foot tower anchored to the roof of my house and a home-brew tilt-over all-band vertical separated by 45 feet from the tower, I used these as supporting structures for some horizontal antenna experiments. After installing a pulley and nylon rope on each of these I was able to pull up any type of wire antenna I wanted. I looked at antennas like the "W8JK" (and variations of it) and the "ZL-SPECIAL," but decided to give the multiband dipoles fed by one common feedline a try.

The problem with them is that unless you can really separate the wires from each other enough, there tends to be a lot of coupling between the individual dipoles. And as a result, there is a lot of interaction which, because of capacitive coupling, makes them hard to load up on each individual band and also causes high SWR readings.

This is especially true for the ones made from rotator cables or open wire feedlines. Stay away from them—you will be wasting your time, unless you use a good antenna tuner. But then you are only fooling yourself into thinking that your antenna presents a perfect match, and all your RF is being radiated into space. After all, your SWR is almost 1:1, right? Wrong!

Unless your antenna presents a purely resistive load (as should be the case with a resonant antenna like a dipole or a nonresonant traveling wave antenna, such as a terminated long wire, or a terminated rhombic antenna, etc.) a good percentage of your RF is being radiated within the confines of your tuner and not getting anywhere, just being converted into another form of energy, which we call "heat."

Constructing a Multiband Dipole

Disappointed by these experiences, I decided to make a conventional dipole for 20 meters. Using 14-gauge insulated automotive stranded wire, I started with the proper length, based on the formulas in the *ARRL Antenna Handbook*, which of course were meant for bare copper wire.

Here is where I found out about the effect of the insulation on the wire. I ended up with a dipole that was much shorter than I had anticipated. Each leg of the 20 meter dipole made from bare 14-gauge wire would normally have been about 198"; instead, mine was 193.5".

Quite a bit of difference. My SWR was 1.2:1; not bad. It got out pretty good like a dipole should, and I had less trouble with interfering stations from the sides.

Then I decided to attach a second dipole to the first one, this time for 17 meters, and made it from 16-gauge automotive insulated wire, simply because that is what I had available. The length for each leg was now 157", as opposed to 161" for bare wire.

I experimented with the spacing between the legs of this 17 meter dipole, and the 20 meter dipole. I found that as long as I kept the angles between each leg at least 12 degrees I had a low SWR, still 1.2:1. Then I added a third set of legs made from the same 16-gauge wire, this time for 15 meters, using the same 12 degree spacing. The length for each leg was 133.5", as opposed to 141" for bare wire. Any more dipoles would have meant an angle of close to 90 degrees for at least the fourth dipole. This was not acceptable to me. Therefore, I kept it as a three-band antenna with a SWR of 1.2:1 or better.

So now I had a three-band dipole, bi-directional, with sufficient side rejection to make it more useful than my old faithful all-band vertical in most cases.

For those of you who would rather have a 10 meter addition instead of any of the other bands: The dimensions for each leg will than be 96.75" for 16-gauge insulated automotive wire, and 98" for bare wire.

See Figure 1 and details A, B and C for all the construction information. The coaxial choke in detail A consists of four turns and 4" i.d., suspended about 8" below the dipoles. It is part of the same feedline which goes to my station, and is kept together with three or four nylon ties. Or use silicon rubber instead.

The purpose of this choke is to keep your feedline from radiating, which can not only distort your field pattern but also radiate RF into areas where you don't want it (like your neighbors' telephone, VCR, TV, hi-fi, or the fillings in their teeth, etc.).

Detail C shows how I weighted down this multiband dipole with curtain weights by drilling holes in them and slipping them over the nylon suspension ropes. I used about 10 on each side, and that kept the antenna stable under most conditions. Try your local hardware store or interior decorator for these things.

The Dream of a Wire Beam

After successfully using this multiband dipole for a while, a new idea came to my mind. I remembered reading articles about hams using identical wire loops, spaced from each other, each with its own feedline, to make cubical quads. While they were being installed in a fixed position these quads could be made to change directions simply by adding a coil with the proper dimensions to the feedline of the loop which was not hooked up to the rig. This was to make it longer, making it act as a parasitic element. Thus, by feeding one of the loops, the other could be made to act as a reflector.

After eliminating the 17 meter dipole, I was left with only 20 and 15 meters, still being kept 12 degrees apart (57" between the insulators). After satisfying myself that

Continued on page 34

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Touch-Tone Squelch

Remote speaker control with a DTMF decoder.

by Patrick Wong VE3RGW

DTMF (dual-tone multi-frequency) is a very successful and popular remote control system. We can hardly imagine a hand-held radio without a touch-tone pad. First generation DTMF decoders typically used passive LC filters, active filters or phase-locked loop techniques to decode DTMF tones. They were either expensive or they suffered serious drift with changes in temperature or humidity.

DTMF decoding ICs are much cheaper and reliable now. This article describes how to build a general purpose DTMF decoder with a low-priced chip from MITEL. The circuit supports DTMF squelch based on a three-digit station ID (full 999 combination). It also supports decoding of four additional commands—station ID, plus one more digit which can be used to perform remote control on external devices (on/off or single-shoot trigger operation). One expansion port is included to allow future development.

The core of the whole equipment is the MT8870 DTMF decoder. This is a state-of-the-art single-chip DTMF receiver incorporating switched capacitor filter technology and an advanced digital counting/averaging algorithm for period measurement. Conventional methods of frequency decoding are usually based on frequency-counting or phase-locking techniques. These methods are time consuming and inaccurate when handling unsteady, complex signals.

Switched capacitor filter technology is based on a completely different approach. It works on the theory that any AC signals are rapid changes of potential energy under specific timing. AC components, provided they bear the same frequency characteristics, will have the same timing on instantaneous potential variation. For example, a signal of 1 Hz frequency will experience a peak positive value once every second. The duration of one second will be constant among any AC signals bearing a 1 Hz frequency, even though they have different waveforms.

Suppose a circuit is designed to sample the potential value of a signal at preset intervals (say, at exactly 90 degree phase-shift timing for a specific frequency). If signals are really present but the total sum of all samples always experience zero, we can conclude that an AC component of that specific frequency has been identified. Each fixed timing will be good for only one frequency. Since DTMF is a combination of four row tones and four column tones, it will need at least eight sets of such time-switching circuits. In the real world, there are more than eight sets of such circuits in order to handle acceptable frequency tolerance in the incoming DTMF signal while decoding results are developed on an averaging of outputs from all these filters.

Error Detection Control

There are two kinds of DTMF detection errors: TALKOFF and TWIST.

TWIST is the failure of decoding a valid DTMF signal due to non-linear frequency response of a transmission media. Among the two enemies, TWIST is easier to deal with since it can be controlled by audio equalization on the whole transmission path. These equalizations can be done internally inside the DTMF decoding chip, or externally as additional filters. According to factory specification, MT8870 can stand TWIST tolerance of +/-6 dB. That is quite sufficient to compensate for the pre-emphasize and de-emphasize distortion caused by FM media. This should not be a problem unless the transmission is highly distorted.

TALKOFF is the incorrect recognition of the DTMF component in human voice as true DTMF signal. This is an unavoidable factor since human voices do contain valid DTMF combinations. Fortunately, the presence of these valid components is unsteady. Unlike real DTMF from a touch-tone keyboard or generator, these "human" DTMF signals cannot maintain a constant combination, so they can be isolated by DELAY discrimination. If a decoded DTMF signal can stay on constantly for a certain duration which exceeds those normal periods experienced in human voice, then it can be identified as a real DTMF command.

Look at the schematic circuit. There are some external components hooked to MT8870 (C2,R11,R12,D9). Pin 16 of MT8870 is the EST (early steering) output. It will flag logic high whenever there is a DTMF combination present in the input signal (including TALKOFF error detection).

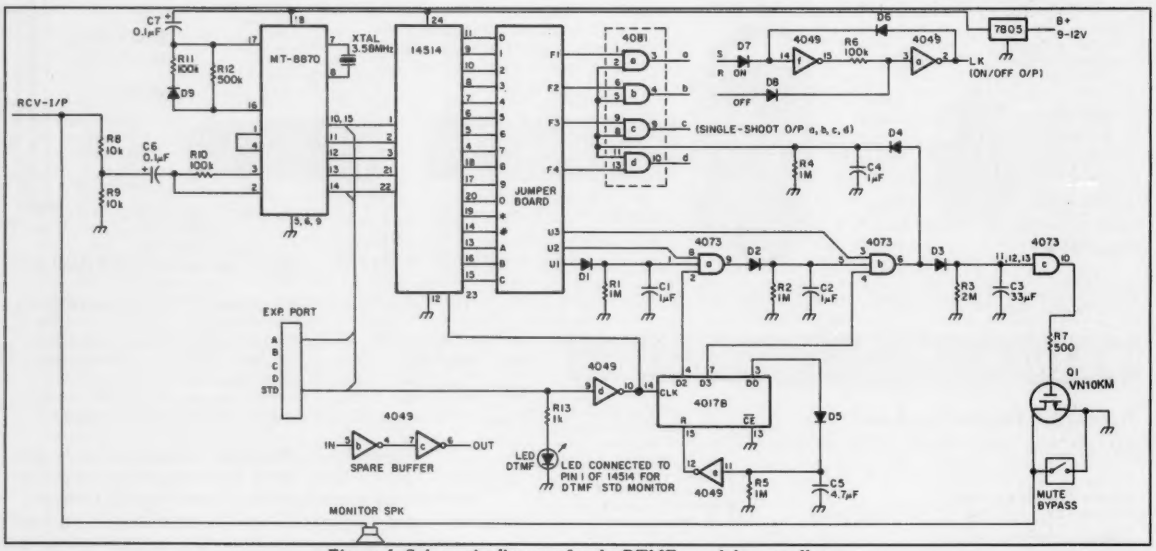

Figure 1. Schematic diagram for the DTMF squelch controller.

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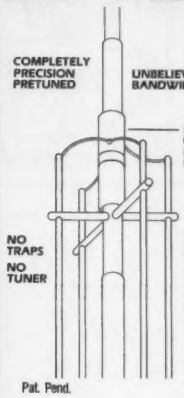

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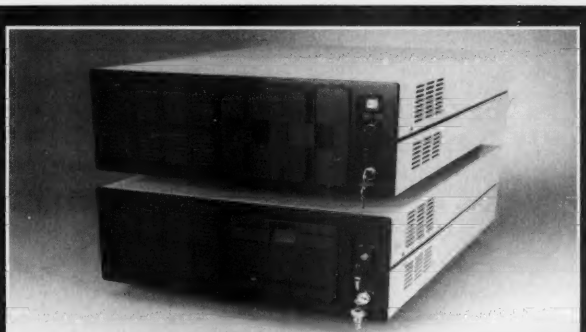

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CIRCLE 74 ON READER SERVICE CARD

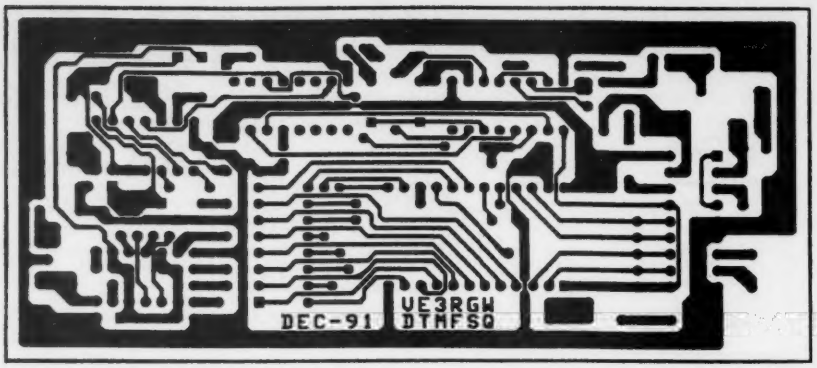
Pin 17 is the GT (guard time) control; it is a trigger-type input. The level on pin 17 is arranged as a delayed EST via C7 and R12. If the detection of DTMF is long enough for voltage at pin 17 to build up with time, it can be considered a valid DTMF signal. The STD output line (pin 10) will flag logic high since it is connected to output data, enable (pin 15). That will enable lines (pin 11,12,13,14) to present a numeric value for the decoded DTMF data. Yet, it takes the same delay for an RC circuit to discharge. That means TALKOFF detection can still occur after a valid DTMF signal has disappeared while C7 is still charged up. That is the reason for including D9 and R11. They are there to provide a fast discharge on C7 and ensure an immediate full delay guarding once a valid DTMF tone is gone.

Circuit Operation

The circuit is pretty straightforward. The MT8870 monitors any audio coming from the receiver. The internal speaker of the receiver is muted while the external monitor speaker is switched by Q1 or a manual control bypass switch (Q1 is driven by the internal command decoding logic).

The decoded BCD numeric data follows the format shown in Table 1. This data is decoded into 16 individual outputs by the hex decoder. Simply speaking, if you received a DTMF "*" entry, you will get a logic high on pin 19 from the 14514. All these 16 outputs are connected to the program board, which is only a 16-pin DIP IC socket. U1-U3 and F1-F4 are input wires to the command decoding logic. The command programming is completed by jumping these wires into the corresponding pins on the program board. For example: If you want to program your station ID as number [330], you just have to plug wire U1 to pin 3, U2 to pin 3, and U3 to pin 10 of the program board—it's as simple as that!

The command decoding logic is just a bunch of gates combined with RC delay circuits, thanks to the extra high input impedance of CMOS. That makes it possible for electric charges to stay at their inputs for hours until absorbed by a shunting resistor. Let's take one simple section as an example. Look at the 4081 dual input gates. They form a simple two-digit command decoder. They are all connected to an RC circuit formed by R4 and C4. This RC will form a delay of about one second. That is to say, if there has been a logic high coming through D4, C4 will keep the charge and R4 discharges the circuit to a logic low level within one second. If another logic high is received on the second input (F1-F4 matches a selected DTMF tone received) before the discharge is completed, the selected gate will open and a logic high will appear at the output. This output can be used to drive external circuits. To change the delay duration, just change the RC values. The larger the resistance or capacitance, the longer the waiting delay on the second digit.



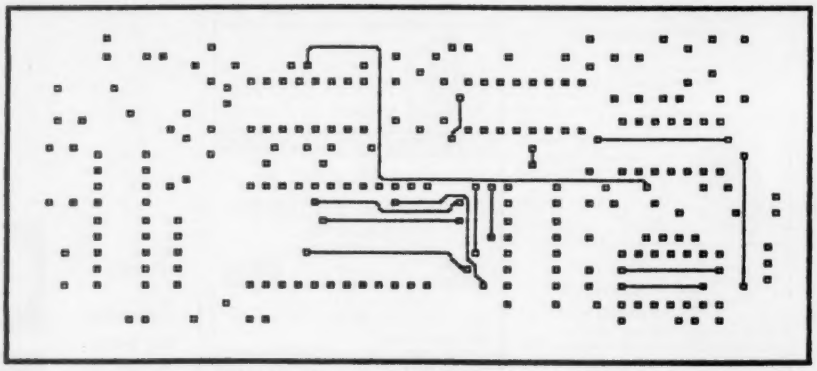


Figure 2 (a). PC board foil pattern (bottom layer). (b). Top layer.

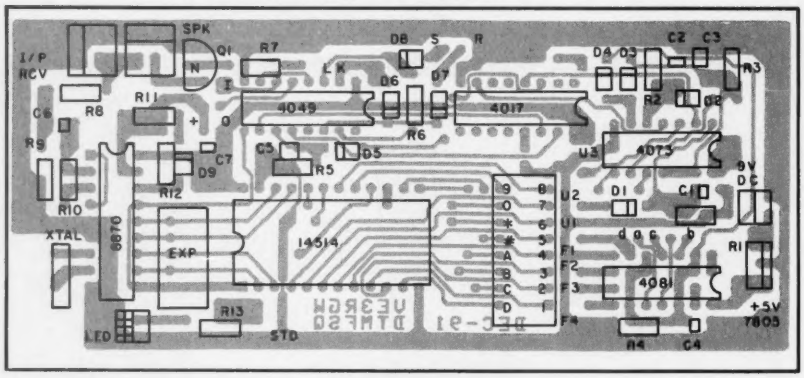


Figure 3. Parts placement.

One factor which affects the accuracy of these timings is humidity. This effect will be further emphasized if the resistance value is high (say, exceeding 5 megohms). A delay longer than 120 seconds is not recommended, although it can be approached (the typical value for a 120-second delay is 5 meg/47 μF). I chose tantalum capacitors because they are smaller and enclosed in a better package. Also, they can stand higher changes of temperature and humidity.

Now, let's look into the command decoder in more detail. U1, U2, and U3 are programmed as the station ID number. The 4017 is a decade counter equipped with auto-reset ability (via D5, R5, C5, and inverter E). The D0 pin is the output of decade stage 0, and it will stay logic high as long as the counter stays idle. C5 is charged up continuously until the first DTMF entry is detected. That causes the counter to step up by one, and D0 will go to a logic low status while D1 goes to a logic high state. Once that happens, the charge at the input of inverter E will be discharged by R5 and approach logic low within three seconds. In this three-second period the counter can still count DTMF activities and move the logic high status from D1 to D2 if a second DTMF tone is detected. Once the three seconds have passed, the 4017 will be reset and all command entry has to start from first digit again.

If the first digit of the DTMF entry is correct (matches U1), two inputs of the 4073 will be on logic high (supplied by 4017 D1

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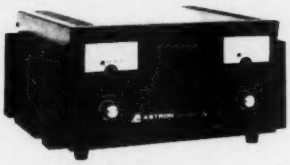

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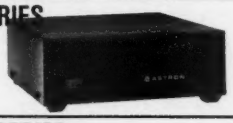

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• LOW PROFILE POWER SUPPLY						
SL-11A	•	•	7	11	2¾ x 7⅞ x 9¾	11

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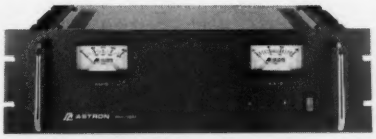

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MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• 19" RACK MOUNT POWER SUPPLIES				
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

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MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

output and charged up C1). If the second digit of the DTMF entry is also correct (matches U2), the output of 4073/section A will go logic high and charge up C2. At the same time, since 4017 will move the logic high to its D2 output, the 4073/section B is now ready to decode the third DTMF digit via U3.

If a logic high is received from U3 within one second, a logic high will be presented from 4073/section B and charge up the two following circuits. The first is a 45-second delay formed by 4073/section C (just a buffer), the output of which will drive transistor Q1 and activate the external speaker until time-out. That is how the DTMF squelch becomes unmuted by detecting the station ID. The previously mentioned 4081 dual input gates are connected as additional remote control command decoders. Once station ID plus one more matching DTMF digit is received (programmed by F1,F2,F3,F4), the output of the corresponding 4081 will turn logic high while external devices can be triggered via the output points (a,b,c,d).

Additional Control Features

One special section is provided by the hex inverters. Sections A and F of the 4049 are connected as a toggle flip-flop. If a logic high is received on the [on] input, the output will stay logic high until another logic high is received on the [off] input. This is just an example of how to construct a self-locking on/off control circuit. You can connect output [a] to [on], and output [b] to [off], in order to program the [on] command as [station ID + F1] while the [off] command is [station ID + F2]. More control can be obtained in the same manner just by adding similar circuits.

If any error occurs in the command sending sequence, the counter will prevent further decoding immediately until the self-reset function executes. So, any command must be entered correctly within three seconds after a start. Do not hesitate more than one second between any two digits or the decode will fail due to time out. With such digit-by-digit checking, repeat numbers can be used consecutively in the station ID (except that digits F1,F2,F3,F4 should not be the same as U3 or the 4th digit for that command will be ignored). The command circuit will fire after the reception of the station ID since the whole four-digit command is already received, even though the user has not yet sent his fourth DTMF tone!

Since only four units in the 4049 hex inverter are in use, the two spare units are connected in series (on the PCB) as a spare non-invert buffer. This can be used for future expansion or making the LED monitor become a high impedance logic probe. This simple device is very useful for diagnostic work at the construction stage. As shown in the circuit diagram, the LED is connected to show DTMF detection, while the 4049 buffer is left vacant. Users can determine their own needs and change the connection accordingly.

DTMF character	Output data line DCBA
D	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
0	1010
*	1011
#	1100
A	1101
B	1110
C	1111

Table 1. Decoded BCD numeric data format.

Tune-Up and Testing

The only precaution to take when working with construction of this type is to be careful with static discharge on CMOS ICs. All the ICs should be kept inside their anti-static packaging until the last moment before they are transferred to the PC board. To avoid unnecessary damage, first solder all the jumpers on the component side. Then put on all the IC sockets. This sequence is important since some jumpers are hidden under the sockets. They will no longer be accessible after the sockets are in position. Next, put on all the resistors, diodes, capacitors, the crystal, Q1 and the LED. Finally, put on the 7805 regulator.

Connect DC power to the +Vcc input and measure voltage for the pins at all the IC sockets. You should see +5 volts ONLY on the Vcc supply pins. If +5 volts appears on any other pins you probabaly have a short circuit somewhere. Check out those shorts before an IC is toasted because of carelessness, then check the conductance of all the ground pins are actually grounded. Make sure the return path is also good.

Remove DC power from the board. Now you can insert the ICs onto the PC board and test them out one by one. First insert MT8870, then power on the board. Connect the RCV input to the speaker output of your receiver. Assume that the LED has been connected to the DTMF strobe line as suggested. Send DTMF tones into this receiver and increase the volume control of the receiver from silence until the DTMF LED on the PC board lights up. The LED should turn off once the DTMF tone is gone. MT8870s have a very wide dynamic range for the input DTMF level, so even very weak audio is sufficient. Don't overdrive the circuit; distorted DTMF is no good for decoding.

After you have verified that the chip is able to decode DTMF, enter all 16 tones and make sure every one makes the LED flicker. Next, use the voltmeter to check out the five data lines at the expansion port. STD should flag logic high (+5V), just like the LED does. The activity of the other data line should respond exactly as shown in Table 1.

Remove DC power and insert the MC14514, 4049 into the circuit. Turn the power on again and enter all 16 DTMF tones. Make sure a corresponding logic high can be seen on the correct pins at the program board.

Remove power again and insert 4017, 4081, 4073 onto the PC board. Complete the necessary programming for U1, U2, U3, F1, F2, F3, F4, then turn the power back on. This time, hook the voltmeter to pin 3 of 4017, then send in one DTMF tone. This pin should be logic high on idle, go logic low immediately after DTMF received, and restore logic high automatically within three seconds. Check out the inverter or D5,C5 and R5, if failure occurs. Also, make sure the logic high stage moves from pin 3 to pin 2, then to pin 4 of 4017 with consecutive DTMF entries.

Wait for three seconds (to ensure 4017's self-reset). Connect the voltmeter to pin 6 of 4073. Send in the DTMF tone for the station ID (U1 U2 U3) and make sure a logic high flickers once on the voltmeter. If this is successful and the external speaker is connected, you can hear the monitor speaker switch on. It will stay on until time-out occurs on R3 and C3 (within 45 seconds).

Move the voltmeter to the output of 4081 (pin 3,4,10,11) and check out their activity on sending in commands ID+F1,ID+F2, ID+F3 and ID+F4. If you have connected output [a] to [S] and output [b] to [R], by performing the above test on ID+F1 and ID+F2 you can also cause an on/off activity on output [LK].

The decoder is considered tested out after all of the above has been completed.

Endless Possibilities

The above is only a start for your entering the world of DTMF control. By using these DTMF switches, you can create unlimited applications.

Parts List

MT8870		Mitel DTMF decoder
MC14073 or 4073		Triple three input AND gate
MC14081 or 4081		Quad dual input AND gate
MC14017 or 4017		Decimal counter
MC14049 OR 4049		Hex inverter
MC14514		BCD to HEX decoder
7805		5-volt regulator > 50 mA
Q1	VN10KM	Power FET
R1	1M ohm	1/4 watt
R2	1M ohm	1/4 watt
R3	2M ohm	1/4 watt
R4	1M ohm	1/4 watt
R5	1M ohm	1/4 watt
R6	100k ohm	1/4 watt
R7	500 ohm	1/4 watt
R8	10k ohm	1/4 watt
R9	10k ohm	1/4 watt
R10	100k ohm	1/4 watt
R11	100k ohm	1/4 watt
R12	500k ohm	1/4 watt
R13	1k ohm	1/4 watt
C1	1 µF	30V tantalum
C2	1 µF	30V tantalum
C3	33 µF	10V tantalum
C4	1 µF	30V tantalum
C5	4.7 µF	16V tantalum
C6	0.1 µF	16V electrolytic
C7	0.1 µF	30V tantalum
D1-D9	1N914 or equivalent switching diode	
LED	low power consumption type	
IC sockets 24 pin x1, 18 pin x1, 16 pin x3 , 14 pin x2		

Etched and drilled PC board is available at $12 plus postage; the unassembled kit is $41 plus postage. Order from: Patrick Wong VE3RGW, 10 Halder Cr., Markham, Ontario, L3R 7E8, Canada.

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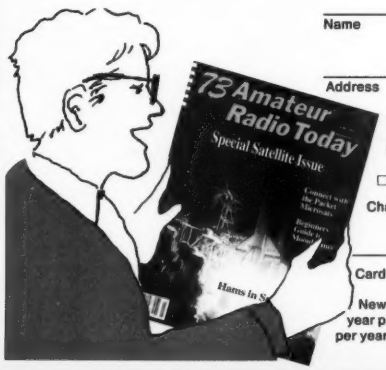

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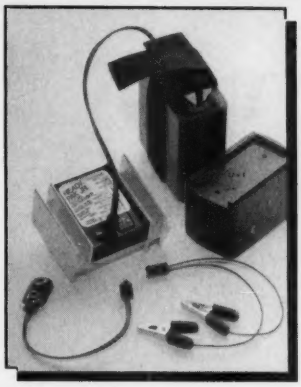

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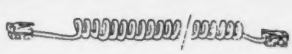

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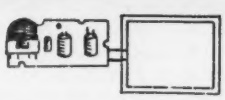

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CIRCLE 194 ON READER SERVICE CARD

Build Your Own 20 Meter Transceiver

Work the world with this easy-to-build rig.

by Gordon Young WB6NKJ

This project is perfect for the low-power enthusiast who wants full break-in (QSK), sidetone and diode antenna switching features. The parts for this project are common and even a first-time builder should have little or no trouble assembling a complete transceiver. You will be surprised at the results and happy with the simple features this rig provides. I have already logged many stations and have put on many hours of use, talking across the states and around the world with just a few watts. An advanced builder may consider adding RIT, audio filtering, a frequency counter, a drive control, or other features.

The power output will easily drive a pair of high-power transistors to a level greater than 100 watts, but alone it is enough power to work almost any station you can receive. With some tinkering, you can bring the MRF-433 transistor to its full 12-watt capability.

I am always surprised at the performance of simple direct-conversion rigs, and this one is no exception. The circuit is simple, construction is easy, and normal operation is a pleasure considering that the transceiver is so simple. I've worked all states before with just 5 watts; this rig should do the same for you.

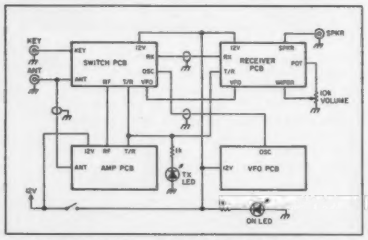

Figure 1. Transceiver block diagram.

The Circuit

Figure 1 shows the block diagram of the transceiver and it is readily apparent that it contains the basics: a signal input, a detector, VFO, audio amplifier and RF PA. This started as only a weekend project, but I wanted to make sure that it had some of the nice features I grew to depend on, such as a sidetone, diode antenna switching, and audio output to drive a speaker (headphones begin to get uncomfortable after hours of operation on Field Day). The other annoying aspect of full QSK is the "thumping" you normally get switching from transmit to receive. The cause of this is the DC dumping of the audio stage. To help overcome this problem I used a simple transistor switch between the detector and AF preamp. This switch doesn't really tackle the mismatch of impedances at this point; an FET would be better.

Another objective was that the power amplifier have enough guts to drive a linear stage to later follow the transceiver project. If you have a pair of 80-watt devices, they will require at least 5 watts of drive, and pushing the MRF-433 to 12 watts would mean that an attenuator would likely be needed somewhere in between.

The outcome of the entire effort is shown in the figures. In my prototype, each part of the rig was originally air-wired on plates of PCB board. However, etched and drilled are available to ease your construction efforts (see the Parts List).

Starting with the receiver PCB, the front-end bandpass filter helps a lot to reduce the foreign broadcast interference that would overpower receivers such as this. To make up for the few dB lost in the filter and to add

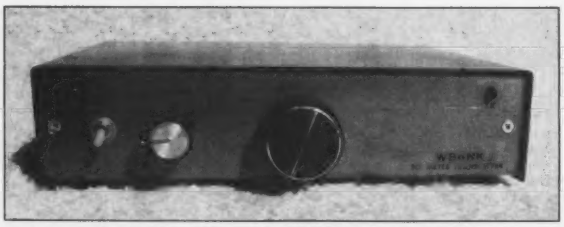

Photo A. The completed WB6NKJ transceiver.

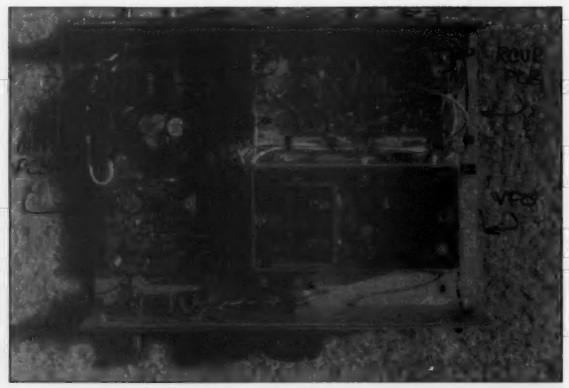

Photo B. Inside view of the transceiver.

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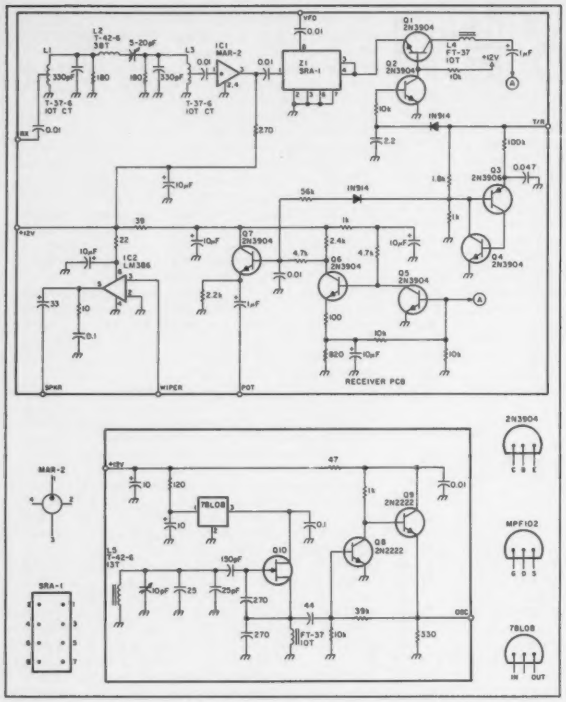

Figure 2. Schematic diagrams for the receiver (top) and VFO sections (bottom).

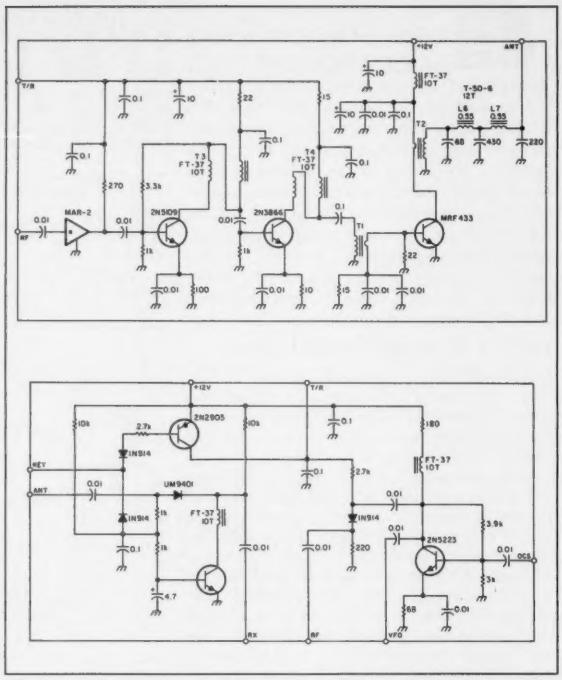

Figure 3. Schematic for the RF power amplifier (top) and the switching board (bottom).

some amplification ahead of the detector, a Mini Circuits MAR-2 (+13dB) amplifier is used. You can improve the performance somewhat by substituting an RCA MWA-130. Both are IC amplifiers and require very little more in the way of components. Since these are broadband amplifiers you need a bandpass filter ahead of them. Another Mini Circuits device, an SRA-1, is used for the detector. This represents another 6 dB of loss, but fewer components are used to complete the detection stage and the loss can be easily made up for in the audio preamplification stages.

Q1 and Q2 disable the detector during transmit mode and

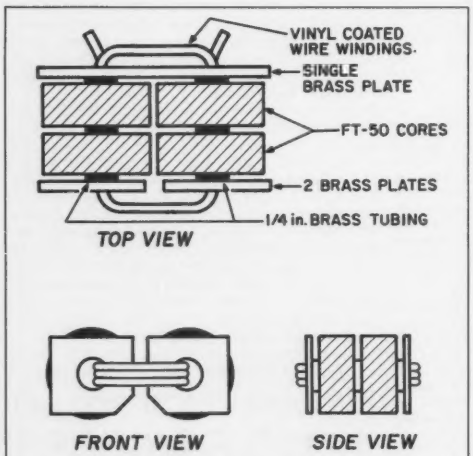

Figure 4. Broadband transformer winding information. T1 is constructed as shown above using just 2 FT-50 cores and a 7-turn primary. T2 is built as shown here with a total of 4 FT-50 cores and a 7-turn secondary.

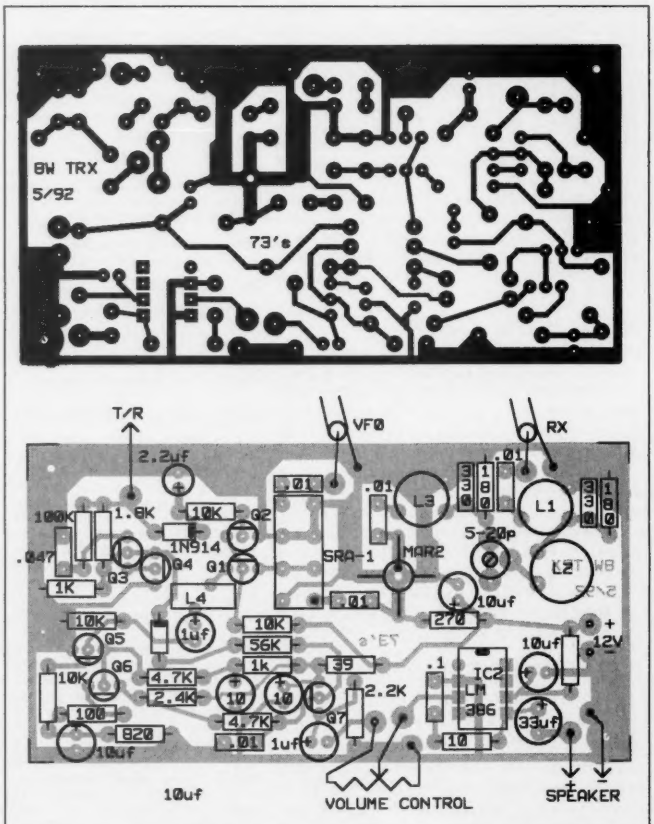

Figure 5. a. PC board foil pattern for the receiver board. b. Parts placement.

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help reduce the "thump" problem. From here the audio signal is fed to a high gain preamplifier with Q5, Q6 and Q7 before driving the LM 386 audio power amplifier. These stages are not muted during transmit and the small level sample from the keying sidetone is fed to Q7. The simple sidetone circuit offers a very comfortable tone and is simple to construct. Originally, the bag of transistors I used for Q3 and Q4 were such that I had to play with the value of the Q3 base resistors before it would oscillate.

The VFO board is one where you should consider taking every precaution necessary to eliminate problems. At 14 MHz, VFO drift is more apparent than at 3.5 or 7 MHz. Be sure that you obtain good temperature grade capacitors on the frequency determining LC sections. Glass or silver mica capacitors would be a good choice for the 25 pF values and L4 should be coated with Q-Dope and mounted rigidly. IC3 is an 8-volt regulator and is placed as physically close to the MPF-102 as possible. Q8 and Q9 are 2N2222 transistors used to raise and buffer the VFO output. While you may not have the 10 pF tuning capacitor that I used, anything that you have that will provide the proper range will work. VFO shielding is a must and will get rid of many problems later on.

The switch PCB uses three transistors to handle the keying and T/R line, antenna signal switching to the receiver, and a VFO amplifier which is used to feed the detector as well as to drive the RF amp stages. A diode is used in the collector of Q16 to block or pass the VFO output to the RF amp. The original transceiver used a 1N914, but you may choose to improve this to a better switching type.

When the RF is sent to the PA stages, IC4, Q11 and Q12 raise the signal level enough to drive the MRF-433 final. These are all broadband stages and information is provided later on transformer construction. A low-pass filter will reduce spurious signals on the output.

Table 1. Coil Information

L1, L3	10 turns of #24 wire on Amidon T-37-6 (yellow) toroids. Each coil tapped at center (5T).
L2	38 turns of wire on a single Amidon T-42-6 toroid.
L5	13 turns on Amidon T-42-6 toroid core. Use Q-Dope.
L6,L7	12 Turns #20 wire on Amidon T-50-6 cores.
L4,L8-L11	10 turns of #24 wire on T-37-6 toroid.

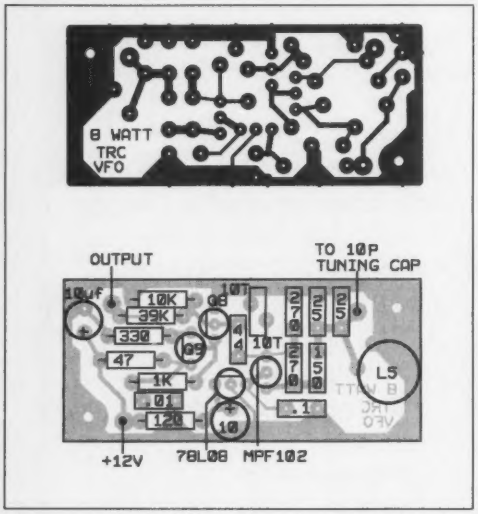


Figure 6. a. PC board foil pattern for the VFO board. b. Parts placement.

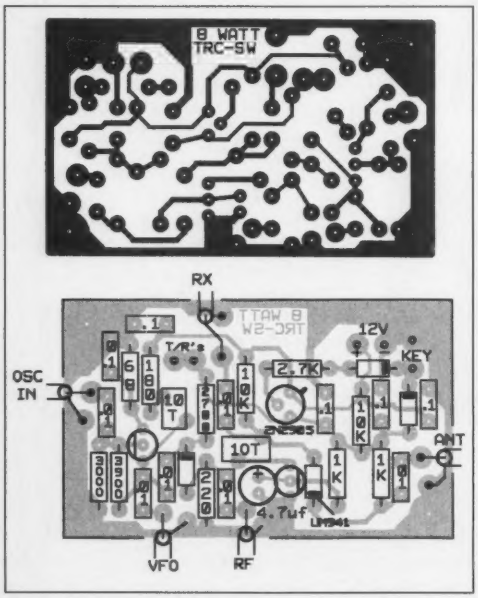
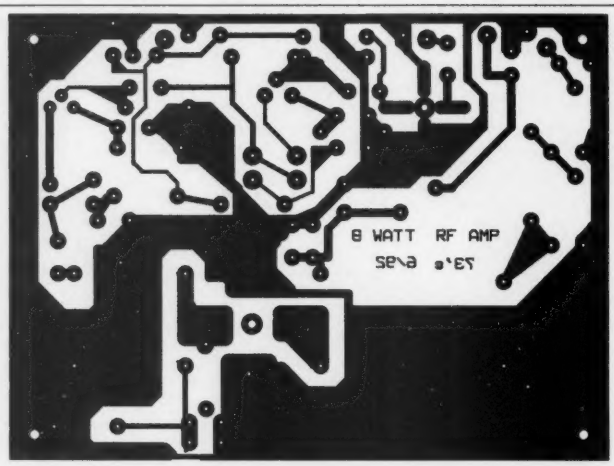


Figure 7. a. PC board foil pattern for the switching board. b. Parts placement.



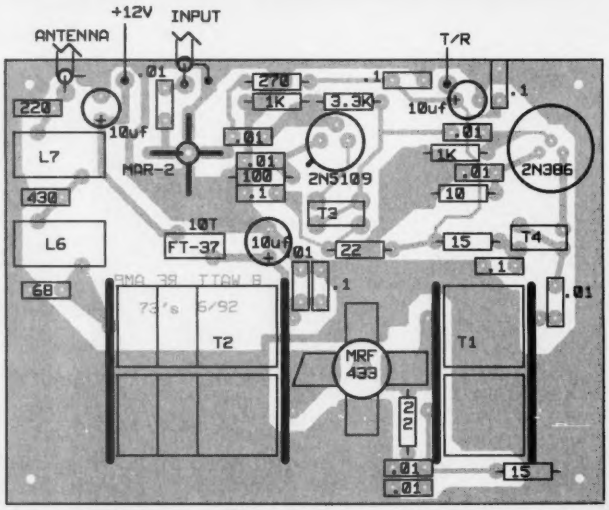


Figure 8. a. PC board foil pattern for the power amplifier board. b. Parts placement.

HF Equipment — Regular — SALE

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Accessories for IC-781/765/765/726/725 • CALL

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IC-4SRA 440MHz/25-905 rx	600.00	**509.95**
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IC-4GAT 440MHz/TTP	372.00	**319.95**
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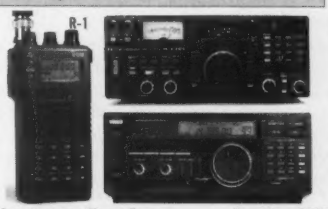

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R-1 100kHz-1.3GHz AM/FM handheld	$533.00	**469.95**
R-71A 100kHz-30MHz rcvr	1019.00	**869.95**
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FL-32A 500 Hz CW filter	69.00	
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You may elect to tinker with the input and output transformers so that more output can be realized from the MRF-433. The device has a rated output of 12 watts, and it shouldn't be too difficult to alter this layout.

Construction

This version of the transceiver was mounted in a 2″ x 5″ x 7″ cabinet and there seemed to be plenty of room for everything except the speaker! It was constructed using four circuit boards. The VFO should be separate since it is to be enclosed in its own cabinet. I opted for separating the RF stages because it required a heat sink, but there is no reason you should not combine the switch stage with the receiver. Be sure you connect RF signals from stage to stage with small RG-175 coax cable. The size and type of the T/R and speaker leads is not of much concern. The photographs illustrate the original layout.

Bifilar-wound coils are used at the collectors of Q11 and Q12. Each has 10 turns. T1 is fabricated from brass stock and brass tubing using 2 FT-50 Amidon cores. The tubing represents one turn of wire, and the primary is seven turns of insulated teflon wire. T2 is basically the same as T1, with the exception of using four FT-50 cores. The secondary also contains seven turns for an approximate impedance ratio of 7:1. See Figure 4 for winding details.

Testing and Operation

Initially, use a frequency counter to set the VFO on 20 meters and adjust the bandspread of the tuning capacitor. If you have an oscilloscope, check that the output signal is 2-4V P-P. This signal feeds over to Q16, which is collector-coupled into the detector and the diode switch so there is some mismatch of impedance. Look for a collector signal of 0.5V P-P. This should be all that is necessary for the initial signal. You might want to align the receiver filter next with a signal generator and oscilloscope. The filter itself is about 2-3 MHz wide and, sweeping frequencies across the 20 meter band, you should see a peak at 14 MHz. You shouldn't have any trouble with alignment if it is constructed as shown.

Connecting an antenna to the jack should bring some CW into the speaker. Use a low SWR antenna before actually keying down. The sidetone will be heard as you key, and if you are using an SWR or power meter in line with the antenna, some indication should be seen. You might couple the output with a turn of wire around the antenna lead using the scope probe and monitor the signal. It should be a clean wave with no ugly stuff riding on top. Playing with the values of the low-pass filter may help clear up any junk you might see.

I have used this rig evening after evening, working lots of stations across the country and overseas. You will enjoy using this simple rig much more with an audio filter inserted in the AF chain as the DX pile-ups get hectic at times. My rig was later modified by adding another stage of amplification after the MAR-2. I found that the signals are almost overpowering and the need for AGC arose. California is not the best state to work DX from and the usual weak Europeans still are heard with this rig.

If this is your first home-brew project, you will be delighted with the results and enjoy many hours of QRP operation. This is a basic transceiver and you can add on features to better suit your needs and operation. My antenna is a dipole located in the attic and nothing has been too difficult to work so I am certain your results will be an improvement over mine. 73

Contact Gordon Young WB6NKJ at 305 Los Arbolitos, Oceanside CA 92054.

Table 2. Voltage Chart

		Receive	Transmit
Q11	E	0	2.6
	B	0	2.3
	C	0	11.7
Q12	E	0	0.3
	C	0	11.7
Q13	C	12.7	12.5
IC1	#3	4.7	—
Q5	C	2.0	—
Q6	C	9.3	—
Q14	C	0	12.0
Q15	C	0	11.7

Parts List

Receiver Board

QTY	Description
1	10 ohm resistor
1	22 ohm
1	39 ohm
1	100 ohm
2	180 ohm
1	270 ohm
1	820 ohm
2	1k
1	1.8k
1	2.2k
1	2.4k
2	4.7k
4	10k
1	56k
1	100k
2	330 pF silver mica
4	0.01 µF disc ceramic capacitor
1	0.047 µF disc ceramic
1	0.1 µF disc ceramic
2	1 µF tantalum
1	2.2 µF tantalum
4	10 µF tantalum
1	33 µF tantalum
1	5-20 pF variable capacitor
L1,L3	10 turns (center tapped) on a T-37-6 core
L4	10 turns on a FT-37 core
IC1	MAR-2 MMIC
IC2	LM386 audio amplifier IC
Z1	SRA-1 mixer
Q1-Q7	2N3904 NPN transistors

VFO board

1	47 ohm resistor
1	120 ohm
1	330 ohm
1	1k
1	10k
1	39k
2	25 pF silver mica (or glass) capacitor
1	44 pF silver mica (or glass)
1	150 pF silver mica
2	270 pF silver mica
1	0.01 µF disc ceramic capacitor
1	0.1 µF disc ceramic
2	10 µF tantalum
1	10 pF variable
1	78L08 8-volt regulator
Q8,Q9	2N2222 NPN transistor
Q10	MPF102 FET
L5	13 turns on a T-42-6 toroid
L8	10 turns on a FT-37 core

Switch board

1	68 ohm resistor
1	180 ohm
1	220 ohm
2	1k
2	2.7k
1	3.0k
1	3.9k
2	10k
7	0.01 µF disc ceramic capacitor
3	0.1 µF disc ceramic
1	4.7 µF tantalum
3	1N914 diodes
1	UM9401 diode
1	2N2905 PNP transistor
1	2N5223 NPN transistor
1	2N2222 NPN transistor
L10,L11	10 turns on a FT-37 core

RF Amplifier board

1	10 ohm resistor
1	15 ohm
1	22 ohm
1	100 ohm
1	270 ohm
2	1k
1	3.3k
1	68 pF silver mica capacitor
1	430 pF silver mica
1	220 pF silver mica
8	0.01 µF disc ceramic
4	0.1 µF disc ceramic
3	10 µF tantalum
L6,L7	12 turns on a T-50-6 core
L9	10 turns on a T-37-6 core
T1,T2	See Figure 4
T3,T4	10 turns bifilar wound on an FT-37 core
1	MAR-2 MMIC amplifier
1	2N5109 transistor
1	2N3866 transistor
1	MRF433 power transistor

Note: Blank PC boards are available from FAR Circuits, 18N640 Field Court, Dundee IL 60118. Price: receiver board: $4; switch board: $3.50; RF board: $5.25; VFO board: $3; all four boards: $13. Please add $1.50 shipping per order.

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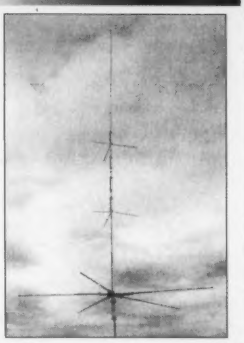


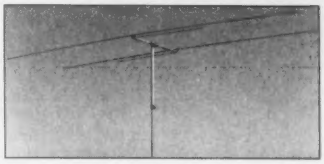
Ideal where space is limited. This easy to assemble HF vertical antenna features stainless steel hardware and a trap design at an attractive price. It can be assembled with the radials to one side for mounting close to a wall.

- Stainless steel hardware
- Ground plane design mounts at any height
- Max. Input: 500W SSB, 250W CW
  3.5 MHz - 200W SSB
- Height: 20'
- 5 Radials (Longest: 51")
- Connector: SO239 Jack

Order #	Price	Description	Weight
HSVK5JR	297.00	5 Band HF Vertical Antenna	17.5 lbs.

6 & 10 METER HORIZON

HB9CV Type UPS Shippable



Dual driven elements at an affordable price. These high quality 6 and 10 meter antennas have an outstanding design that has gained wide acceptance for being dependable as well as compact.

50HS2HB – 6 Meter

- Max. Input: 500W (SSB), 250W (FM)
- Gain: Better than 6.0 dB
- FBR: Better than 16 dB
- Element Length: 116" (2,970 mm)
- Boom Length: 31" (780 mm)
- Connector: SO239 Jack

28HS2HB – 10 Meter

- Max. Input: 500W (SSB), 250W (FM)
- Gain: Better than 6.0 dB
- FBR: Better than 16 dB
- Element Length: 212" (5,400 mm)
- Boom Length: 53" (1,340 mm)
- Connector: SO239 Jack

Order #	Price	Description	Weight
28HS2HB	99.50	28MHz, 10 Meter Horizontal Beam	7.8 lbs.
50HS2HB	69.50	50MHz, 6 Meter Horizontal Beam	5.6 lbs.

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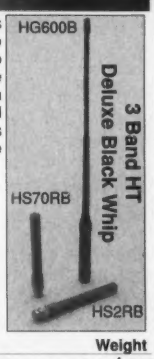
Compact helical formed antennas are flexible and forgiving. Two short single band models and two multi-band designs with coverage to 900 or 1200MHz with gain on the UHF bands. The HG and AH models feature a black low gloss finish, and the HS models are grey silicone rubber.



AH212

Features
- Freq.: 144/440/1200MHz
- Gain: U 144MHz
  3.0dB 440MHz
  5.5dB 1200MHz
- Max. Input: 20W (FM)
- Length: 14" (350 mm)
- Connector: BNC Male

HG600B

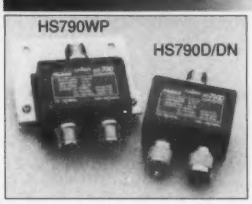
Features
- Freq.: 144/440/900MHz
- Gain: U 144MHz
  1.9dB 440MHz
  3.6dB 900MHz
- Max. Input: 10W (FM)
- Length: 12.5" (320 mm)
- Connector: BNC Male

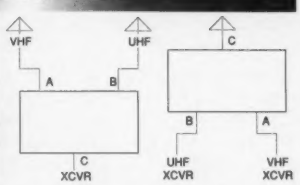
HS2RB, HS70RB

Features
- Material: Silicone Rubber
- Max. Input: 5W (FM)
- Length: 4.33" (110 mm)
- Connector: BNC Male

Order #	Price	Description	Weight
AH212	44.80	144/440/1200MHz Whip Antenna	4 oz.
HG600B	37.80	144/440/900MHz Whip Antenna	4 oz.
HS2RB	12.80	144MHz Whip Antenna	8 oz.
HS70RB	12.80	440MHz Whip Antenna	8 oz.

LOW-LOSS DUPLEXER





- **Frequency:** Port A – 1.6 to 150MHz
  Port B – 410 to 460MHz
  Port C – Common
- **Insertion Loss:** Port A-C – 0.15dB
  Port B-C – 0.25dB
- **Isolation:** Port A-B>60dB
- **VSWR:** <1.2
- **Size (HxWxD):** 1.2" x 2.5" x 1.9" (Excluding Connectors)
- **Power:** 1.6 to 30MHz Max. 500W (FM)
  50 to 150MHz Max. 300W (FM)
  410 to 461MHz Max. 300W (FM)
- **Connectors:**

	A	B	C
HS790D	UHFm	UHFm	UHFf
HS790DN	UHFm	Nm	UHFf
HS790WP	UHFf	UHFf	UHFf

m=male, f= female

- **Weather Proof Model:** HS790WP comes with mounting bracket and stainless steel clamp

Order #	Price	Description	Weight
HS790D	47.50	Direct Link Duplexer	9 oz.
HS790DN	47.50	Direct Link Duplexer	9 oz.
HS790WP	58.00	Direct Link Duplexer, Weather Proof	14 oz.

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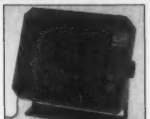

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VE3CYC's Wire Beam

Continued from page 18

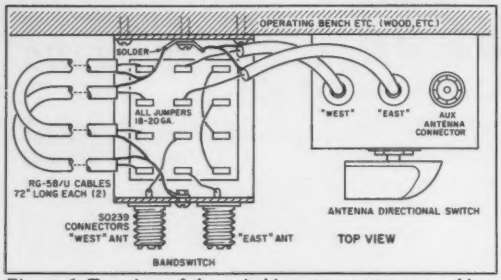

Figure 6. Top view of the switching arrangement to achieve maximum front-to-back performance and to switch directions of the beam. Make sure you don't mount the switches on any metal surface that connects to your station ground.

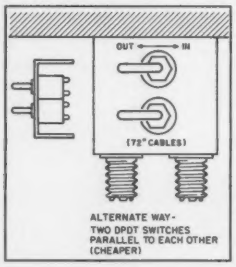

Figure 7. Using two DPDT switches to simulate a 4PDT switch. Make sure you throw both switches in the same direction during use.

everything was still working fine, I proceeded to make an identical twin of the same antenna, including the exact same length of feedline. I used spreaders to keep both antennas exactly 10 feet apart. I chose that distance on purpose because it is roughly 0.15 wavelength on 20 meters, and 0.225 wavelength on 15 meters. This would give me a wide range of gain and maximum front-to-back ratio over most of the 20 and 15 meter bands, with an input impedance of 50 ohms on 21.2 MHz and 20 ohms on 14.15 MHz (more about this later).

The two spreaders I used were made from seven feet of aluminum tubing, with hardwood dowels hammered into the ends and screws added to keep them in place, to make the total length of the spreaders 10 feet. (See Figure 2, and details A, B, C and D.)

The tubing I used was only 5/8" o.d. of soft aluminum, which turned out to be a disaster later on—during high winds they started to bend. I corrected this by making reinforcements (see Figure 3). I would highly advise you to use a heavier wall aluminum, or a larger diameter. You could use 10 feet of tubing as long as you keep it at least some distance away from the ends of the 20 meter insulators (mine turned out to be 21"). In case you do not need the reinforcements shown in Figure 3, have a look at detail D.

Burn the ends of the nylon ropes to prevent unraveling, and use plastic cement on the knots to prevent them from slipping loose in the future. Solder the wires to the feedline right away, and cover them with shrink tubing. You should wait for a few weeks of rough weather, in case the wires stretch and you have to make them shorter, before you solder them permanently at the ends of the dipoles and cover them with shrink tubing. I used a heat gun for my shrink tubing, but you could use a cigarette lighter. If you have trouble soldering the wires, use Acid-core solder. It does wonders on old, corroded wiring. Just make sure you wash all the acid residue off before covering the connections with shrink tubing. I have also used silicon rubber to seal off and keep things in place.

It might not be such a bad idea to make each leg a few inches longer than I have specified. You can then adjust them for the lowest SWR yourself, and cut the excessive length off later on when you are completely finished. Always start by adjusting the lowest frequency antenna first, then work up from there. Each feedline, including the length of the cable used in the coaxial choke just below the antennas and the PL-259 connectors, was 56 feet long at this point.

The Big Letdown

Now I was ready for my great experiment. All I had to do was hook up one feedline, which I will call "east," to my antenna switch, hang a hunk of coil to the other feedline, and...BINGO! I should be able to wake up every ham in Europe.

Boy, was I in for a disappointment. After spending several hours monkeying around with all kinds of combinations of inductors and wires at the end of that unused feedline to make its antenna act like a reflector, the best I could get was a front-to-back ratio of less then 6 dB. I gave up in disgust. I couldn't figure out what the hams in those articles were bragging about.

I yanked off all the wires and coils that I had previously hooked up to the end of that open feedline. All that work for nothing.

The Supreme Beam

Then, while that feedline was hanging there dangling, Europe came in like gangbusters. I could not believe my ears. All of a sudden I had the directional gain I've been after all along. I rapidly hooked both feedlines up to a two-pole antenna switch. And now, by switching between east and west, I really noticed a fair amount of gain in both directions.

After tuning up on 15 meters I had the same experience, but even better. I followed this up by making a few contacts, and the response was good. They all agreed that my antenna was definitely performing like a good beam should. That sure made my day—at least I was up to something good. Now I wondered what made it tick.

What Makes It Work?

The first thought that came to mind was: Since the feedline had a capacity of 28 pF per foot, and I had 56 feet of it, the answer must be there. I had about 1568 pF in series with both legs of my dipoles. (Later on in this article the feedlines will only be 54 feet long.)

This could lower the resonant frequency enough to make the dipoles, which were not connected inside my antenna switch, behave like reflectors. I also realized the theory of quarter wavelengths of feedline, or odd multiples of it, acting like impedance transformers. For example: If you take a piece of 50 ohm coaxial cable, and you cut off 0.25, 0.75, 1.25, or 1.75, etc., times the wavelength of that cable (using the formula for quarter-wave transformers or odd multiples), you will have an impedance transformer.

To put it another way: If I would hook a 25 ohm composite resistor up to one side of this cut-off piece of that feedline, the other side would see 75 ohms. This also means that if I would leave one side completely open, the other side would act like it was completely closed. This would, for all intents and purposes, connect the two halves of each set of dipoles together and make them act like reflectors. And, of course, by carefully manipulating the length of feedline, you get various degrees between completely open or closed conditions.

I am not able to explain mathematically what makes this possible. All I can say is that it works, and it works quit well. I personally feel that the principles of operation are primarily based on a combination of the two theories I have just mentioned: the odd multiple of quarter wavelengths, in combination with the capacitance of the feedline.

Some Arithmetic

According to the formula for a quarter wavelength of feedline (246/frequency in MHz x 0.66); 0.25 wavelength of RG-58/U turns out to be 137.7" for 14.15 MHz, and 91.8" for 21.2 MHz. This means that 1.25 wavelengths of this feedline for 14.15 MHz (5 x 137.7") is 688.5", and 1.75 wavelengths for 21.2 MHz (7 x 91.8") is 642.6".

Now, if you look at the total length of feedline which I am using for 20 meters (54 ft. x 12), which is 648", plus 72" as part of the bandswitch, plus 9" around the bandswitch, you get a total (648" + 72" + 9") of 729".

Then, comparing it to the actual feedline, we are out (729"-688.5") by 40.5" on the 20 meter band. And on the 15 meter band (648" + 9" = 657") it differs from the actual feedline (657"-642.6") by 14.4".

Bad Weather Leading to More Improvements

Now back to business. I experienced a lot of problems on windy days because of the way the 15 meter dipoles were hanging below the 20 meter dipoles. They kept moving toward and away from each other. As a result, the SWR meter went crazy. I took the whole system down and rearranged it the way you see it in Figures 4 and 5 and details A, B, C and D. It made the Wire Beam much more stable.

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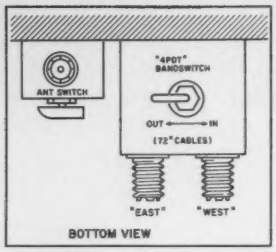

Figure 8. Bottom view of the switching arrangement using a 4PDT band switch.

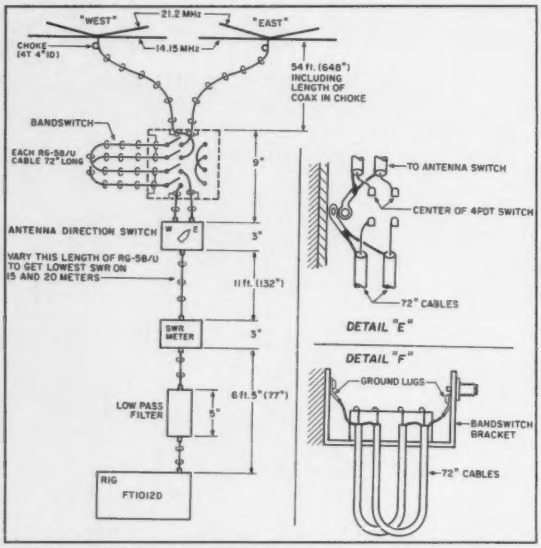

Figure 9. Wiring diagram of the complete wire beam system.

You'll notice the stabilizing ropes in Figure 5 and in the photographs. They are attached to the poles (towers), depending on what you use. This will add in stability on windy days. This is very important for withstanding extreme weather conditions.

Here in Canada, where I live, we get some pretty rough weather sometimes. My Wire Beam has survived 80-miles-per-hour gales, together with blizzards, after first being covered with ice from freezing rain.

Some Fine Tuning

Now that the beam worked, I started doing some fine tuning. I trimmed both feedlines to 54 feet (as mentioned earlier), including the PL-259 connectors. This was done with a switching arrangement, which puts an additional 9" in series with each feedline (I will explain this later in the article).

So, if you feel that you don't want to go into the complexity of an elaborate switching system to be able to switch bands, make your feedlines 54' 9" long. Then you can use the beam on 15 meters as it is. If you want to go on 20 meters, all you have to do is add an extra length of feedline, 72", to each of your incoming feedlines. Now you can work 20 meters and, as you will see later, 10 meters as a bonus. Without the 72" extensions you can work 15 meters, as well as 12 and 17 meters.

Bandswitch Construction

Should you decide to go all the way, you will have to make a bandswitch like I did. Take a good look at Figures 6, 7, and 8, as well at details E and F. Follow my drawings exactly, keep all wires as short as possible, and do not use more than 6" of coaxial cable between the bandswitch and the antenna switch. And don't forget to make all the ground connections exactly the way I marked them off in my drawings. They are extremely important for the beam to work successfully. Don't forget that your feedline should only be 54' (instead of 54' plus 9").

In my bandswitch, I have used a four-pole, double-throw (4PDT) toggle switch, which is a bit expensive and hard to get. If you can get one cheap, consider yourself very lucky. Otherwise, as an alternative you could use two ordinary double-pole, double-throw (DPDT) switches and put them side by side. You could even solder the levers together with a strip of metal, as long as you switch them both together every time. These DPDT toggle switches are a lot cheaper, and readily available. Look for Radio Shack #275-1533 or equivalent.

Now you have to make a "U" bracket for the bandswitch. I used aluminum because it is easy to work with. You have to drill the mounting holes, switch holes, and holes for two SO-239 connectors. Mount everything according to Figures 6 and 7, and details E and F. Keep all wires as short as possible.

All coaxial cables should be RG-58/U or equivalent (the velocity factor of 0.66 is important here). Wrap and solder all coaxial braiding to each other (as illustrated) and the ground lugs (as in details E and F). Use a pair of pliers as a heat sink while you do that, and solder the inner conductors last, after everything has cooled down.

The Antenna Switch

For an antenna switch, you could buy one or make your own. You could use a simple two-way switch, "east" and "west." Or you could do what I did—add an extra SO-239 connector for any future antennas, and have a fourth position to switch all antennas off, as well as grounding the cable which comes from your station (in case of thunderstorm activity).

A Word of Caution

DO NOT MOUNT THE BANDSWITCH OR THE ANTENNA SWITCH ON ANYTHING CONNECTED TO YOUR STATION GROUND. Use only the grounds on the coaxial cables. Don't forget—both switches are now a continuation of your antenna system. Any additional grounds will upset the delicate balance of the system. Mount the bandswitch and the antenna switch as close to each other as possible, and mount them on insulating material, like your station's desk, bench or table.

I mounted my bandswitch with the switch lever facing down, but you might prefer it with the lever facing upwards. That might make it easier to manipulate.

How to Use the Bandswitch

Table 1 shows you to which side to move the lever (or levers) of the bandswitch to get maximum front-to-back ratios on each band. Don't forget—the switch will toggle just opposite of what you might expect. For instance, away from the 72" coaxial cables to switch "in" the coaxial cables, which you need for 20 meters, etc.; and vice versa on the other bands, except 10 meters, which will be the same as 20 meters.

Figure 9 shows how everything is hooked up in my station. The dimensions of all the components involved are important, as are the lengths of all coaxial cables, which include all necessary connectors. This information might come in handy should you run into problems such as excessive SWR readings.

SWR Curves and Some Afterthoughts

I found that I had to do some juggling with cable lengths to get my SWR as low as possible on 20 and 15 meters. I did all my trimming with the cable between my SWR bridge and the antenna switch.

Remember, this beam was primarily designed for 20 and 15 meters, so don't be too critical about high SWR on any other band besides these two. The fact that it worked like a normal beam on 10 and 12 meters surprised even me. I think that this is because the 20 meter reflector might act like two half-wave elements, side by side on 10 and 12 meters, although the driven element is not resonant at these frequencies and probably not too efficient. That is why the SWR readings on these bands are so high.

But who cares? With an antenna tuner you can make the SWR flat, just like with all the other all-banders. On 17 meters its performance is nothing to write home about. It has a slight bit of front-to-back ratio, 6 dB at the most, but hey, it's better than nothing.

No More Worries

There are some extra advantages to this antenna. You have less to worry about when it comes to burglars. They have no idea that you are a ham, and hopefully they do not assume that you have a lot of money tied up in equipment. They most likely think that the Wire Beam is just a receiving antenna, and

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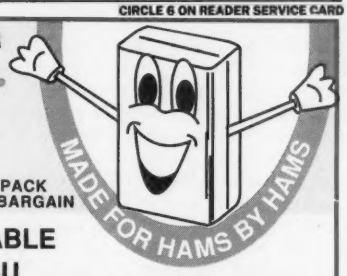

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Band	Bandswitch	Position
20m	72" Extension	switched in
17m	72" Extension	switched out
15m	72" Extension	switched out
12m	72" Extension	switched out
10m	72" Extension	switched in

Table 1. Bandswitch positions.

Band	My S-Meter (avg.)	Their S-Meter (avg.)	Their Min.	Their Max.
20	3.3 S-units	3.0 S-units	2.0 S-units.	4.0 S-units
17	1.0 S-units	0.0 S-units	0.0 S-units	0.5 S-units
15	5.0 S-units	3.5 S-units	2.0 S-units	6.0 S-units
12	2.3 S-units	2.2 S-units	1.5 S-units	3.0 S-units
10	2.8 S-units	2.3 S-units	1.0 S-units	5.0 S-units

Table 2. Average front-to-back ratios on my S-meter vs. distant station's report.

they have not much to gain by breaking in.

Also, when the weatherman forecasts a hurricane, or you go on vacation, you can just lower your beam and let it lay on the ground; then nobody can see it.

Performance

I have been on the air with this beam for a great many hours, and worked all over the world with it. The reports were usually very good. Although it is only a two-element beam, it often behaves like a three-element yagi. I confirmed this by comparing it with nearby hams who were using regular three-element tribanders. Most distant stations could not hear the difference. Sometimes mine came out better.

I must add that my beam is actually aiming about 48 degrees east of north, and in the other direction, of course, 48 degrees west of south. Thus I favor Europe and Asia one way, and California, Mexico and Australia the other way. Since it only takes a split second to change direction I often fool people by switching back and forward. Many people then tell me that I disappeared completely, while a moment before they had given me a Q5 and S7.

Because of the wide lobes associated with two-element beams, I usually had no problems working any station I heard. This is not the same with multi-element monobanders, where you have to keep one hand on your rotator control box when you are in a round table. I can rotate my beam 180 degrees every second, while people with rotators can only do this twice a minute. And look at the price of a commercial beam plus rotator—you're talking about big bucks there. Compared to that cost, the price for buying all the material needed for this beam would leave you enough extra money to buy yourself a dual-bander mobile rig for VHF and UHF, with an antenna and all accessories included.

A Ham's Dream Come True

I have compiled many signal reports over the last several months, and took the average front-to-back ratio reports of stations worked from all over the world. I used information from my S-meter, and from what other hams reported to me from carefully observing their own S-meters. I usually put my FT-101 ZD in the "tune" position so their S-meters would be steady. I wrote all the front-to-back readings down at the time.

Table 2 shows the average front-to-back ratios for each band. I compiled this information by observing my own S-meter and using the reports of the hams I worked, who were observing their own S-meters. I have always made sure that I only observed signals which I received direct, from either the front or back of my beam. The minimum readings might have been a result of multipath, of reflections of objects, or of atmospheric conditions.

Don't forget, when I say minimum readings, I do not mean low readings. Most of the time I had to use my attenuator. Some hams did not quite understand what I was after, and as a result would say things like: "You go from S9 to 20 dB over S9," so in a lot of cases I had to draw my own conclusions.

The highest front-to-back readings that I observed on my own S-meter went as high as 5 S-units on 20 meters, 7 S-units on 15 meters, 4 S-units on 10 meters, and 4 S-units on 12 meters. And this happened quite frequently.

I worked at least 10 stations on each of these bands, mostly from Europe and the western United States. And I listened to many more to arrive at the average of these figures. I haven't got a clue what the gain over a dipole is because I had nothing to compare it with. I am inclined to think that it is better than a conventional multiband two-element beam, because of the absence of traps.

For the Experimental Types

One could easily duplicate this beam for other frequencies, or even add more frequencies, by adding spreaders at right angles to the original ones. I gave you all the ideas, now just start working on it. How about a similar beam on 80 and 40 meters? Or trying this beam in an inverted "V" arrangement?

According to some empirical calculations I've made, a good starting constant would be about 1.14. For instance, if you figure out the length of the feedlines needed (considering what I have said before about odd multiples of quarter wavelengths), you can multiply these calculated lengths by 1.14 to get the interacting capacitive reactances to make this Wire Beam possible. You will than be in the ballpark to start your trimming.

If you run into problems understanding what I am trying to get across to you, please refer to the many good books on the subject available to radio amateurs. You can start with the ARRL publications, such as the *Radio Amateurs Handbook* and *The ARRL Antenna Book*. And, of course, there are many more. Look for "Uncle Wayne's Bookshelf" in *73 Amateur Radio Today*.

For those of you who do understand, this might just give you some ideas that you have been waiting for. I have tumbled into some principles I was not aware of before. I hope that many of you will take advantage of it, and even build on it. Some day I might see one of your articles in a popular ham magazine, like this type of beam for 160. I don't have the space, otherwise I would try it myself. Good luck! 73

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**Specify tuning range: 26-30, 46-56, 137-150, 150-172, 210-230, 400-470, 800-960 MHz.*

LNW-(*) MINIATURE PREAMP

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- GaAs FET Preamp similar to LNG, except designed for **low cost & small size.** Only 5/8"W x 1-5/8"L x 3/4"H. Easily mounts in many radios.

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LNS-(*) IN-LINE PREAMP

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Low noise converters to **receive vhf and uhf bands on a 10M receiver.** Choice of kit with case & BNC jacks, kit less case $49, kit w/case $74, w/t in case $99. *Request catalog for complete listings.*
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ACCESSORIES

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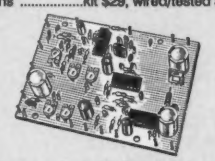

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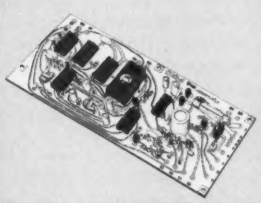
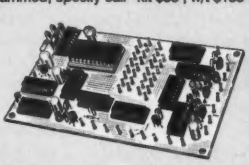


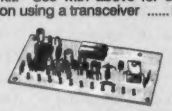
COR-4 kit. Complete COR and CWID all on one board for easy construction. CMOS logic for low power consumption. Many new features. EPROM programmed; specify call kit $99 , w/t $159



TD-2 TOUCH-TONE DECODER/CONTROLLER kit. Full 16 digits, with toll-call restrictor, programmable. Can turn 5 functions on/off. Great for selective calling, too! .....kit $89, wired/tested $149

AP-3 AUTOPATCH kit. Use with above for repeater autopatch. Reverse patch and phone line remote control are std .....kit $89, wired/tested $149

AP-2 SIMPLEX AUTOPATCH Timing Board kit. Use with above for simplex operation using a transceiver .....kit $39



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- Available for the 143-174, 213-233, 420-475, 902-928 MHz bands. ***FCC type accepted for commercial service (vhf and uhf).***
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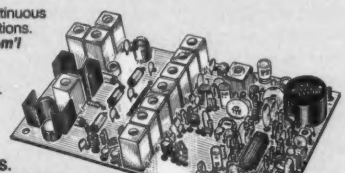

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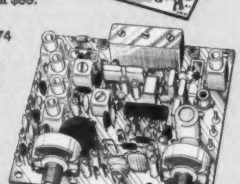

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CIRCLE 57 ON READER SERVICE CARD

73 Review *by Bill Brown WB8ELK*

The j•Com Ventriloquist™

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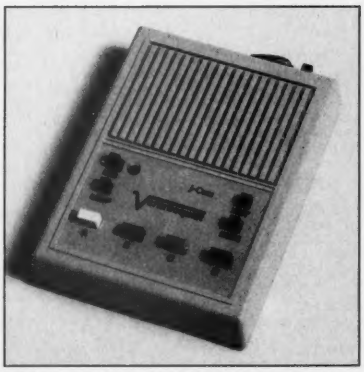

Photo. The j•Com Ventriloquist can store four independant voice messages.

Last year a company called Information Storage Devices introduced a series of new ICs that seemed to be custom-tailored for amateur radio use. One of these chips, the ISD1020, is capable of storing 20 seconds of high-quality voice and instantly playing it back without the usual conversion between the analog and digital worlds. In addition, they designed the chip so that the starting point of any message can be digitally controlled. This chip virtually cried out for someone to turn it into an extremely useful ham radio accessory.

The Ventriloquist

Well, the folks at j•Com have done just that. The Ventriloquist is a device that can store four variable length voice messages. You can play them back individually with the press of a button. Since the ISD chip is based on EEPROM technology, you can completely remove power from the Ventriloquist and it will retain the messages you've recorded for up to 10 years!

Save Your Voice

Anyone who participates in a lot of contesting or likes to chase DX will love the rest that the Ventriloquist will give your vocal chords. For example, you could record "CQ Contest this is——" in message A; "You're 59, 1-Alpha" in message B; "QTH is New Hampshire" in message C and any other information you'd like to convey in message D. You could operate most of the contest with just a few presses of the appropriate buttons.

The Ventriloquist even has a **LOOP** switch which will play back message B in a continuous loop. This is useful for long CQs or possibly even a beacon for foxhunting or as a test signal for you workbench.

In order to make the most out of the limited recording space in the ISD1020, the Ventriloquist has a series of DIP switches that can individually partition the amount of recording space for each message.

Getting the Word Out

The Ventriloquist has a PTT (Push-To-Talk) output line that can key a transmitter. The audio output level is reduced to the level that your transmitter wants to see at its microphone input through an onboard potentiometer (R50) adjustment. In addition, the Ventriloquist has a built-in speaker so you can listen to the outgoing message. There is a MUTE switch to bypass this feature if so desired.

There is a multi-pin jack on the back of the Ventriloquist for power, audio in/out, PTT out and remote control of the message switches. This allows you to interface the Ventriloquist up to the parallel port of your home computer and actually have a program select and activate the messages. For example, the popular contesting program "CT" has an output capable of activating the Ventriloquist as well as other voice devices.

One feature that has great potential is the capability of recording external audio inputs via the AUDIO IN pin. You could tap into your rig's speaker output (you will need to reduce the audio level through an external potentiometer), record the signal from the station you're working and instantly play back their voice as you've received it. This line parallels the internal electret microphone, however there is a jumper in the REV. 1 version of the board that will allow you to bypass it.

Impressions

The audio quality of the Ventriloquist is impressive. However, on higher pitched voices you may notice some slight distortion. This is due to the 2.7 kHz bandwidth of the ISD1020 chip. If you desire higher bandwidth capabilities, you could replace the ISD1020 with the ISD1016 (16 seconds with 3.4 kHz bandwidth) or the ISD1012 (12 seconds with 4.5 kHz bandwidth). However, unless you're after the ultimate in high-fidelity, you won't notice the difference after running it through an SSB transceiver.

Operation of the Ventriloquist is easy. Just push the RECORD switch down, followed by the message button where you want your message to reside. A red LED lights up whenever you're in RECORD mode. On the REV. 1 version of the board, this LED turns green in PLAYBACK mode.

When recording your messages, take care not to talk past the time limit of each message area. Otherwise the "End of Message" bit doesn't get recorded and your playback may include two or more messages.

Message D is played whenever the Ventriloquist is powered up. The folks at j•Com even stored a message at this location that advises you to consult the manual. Of course, you can record over it, but it was a nice touch to have it talk to me the first time I turned it on! If you have the companion enclosure, the audio level from the speaker is more than adequate. However, it will be on the low side if you don't put it in an appropriate enclosure.

The current drain is around 30 milliamps on standby and only 50 milliamps when it talks. As a result, you can operate for some time using just a small battery. Although the Ventriloquist was designed for a 12-volt supply, it will operate from 9 to 16 volts.

Ins and Outs

Since there are so many different types of microphone plugs on amateur transceivers, it's difficult to design a universal interface to hook up the audio output and PTT lines to the transceiver. As it stands, this part of it is left up to the individual user. I just paralleled the audio and PTT lines across my microphone, but this entailed modifying my microphone's plug. It would've been nice to have an adapter to go between the microphone and the rig. Some rigs have an accessory jack that makes the interface easy, however.

The manual shows how to lower an external audio input (via an external potentiometer and capacitor) so that it can be recorded by the Ventriloquist via the microphone input pin. Although it was easy to wire a pot and capacitor in-line, it would've been nice to have this potentiometer built right on the board.

Once I had everything hooked up, I thoroughly the enjoyed the ease of operation that the Ventriloquist provided. It takes up very little space and is a very easy to operate. It certainly is great to throw your voice around the world at the push of a button. ■

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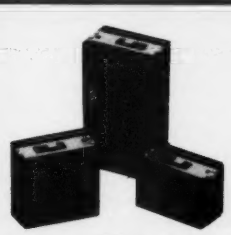

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73 Review

by Mike Baker W8CM

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As soon as I moved from West Texas to Virginia, I noticed that the trees here were much higher, and the tower I brought with me just would not put the antennas where they needed to be. Since I found myself in the market for a taller tower, I took advantage of an opportunity to visit the factory of Heights Tower Systems in Lapeer, Michigan, and meet Drake Dimitry Jr., its president. I had long been interested in having an aluminum tower due to their inherent lower weight and freedom from rust. The quality materials, good workmanship, and exceptional customer responsiveness I found at Heights convinced me that my next tower would come from this company.

The Heights Tower

Heights has been around since 1959, and presently offers aluminum towers that are self-supporting up to 144'. Greater tower heights can be achieved by using guys. The unguyed tower height you can have depends on how much antenna you plan to plant on top, measured in "square feet (SF)" of wind loading near 80 mph. For 144', the maximum is 8SF, while at 80' you can use up to 38SF and still be self-supporting. The actual tower height and loading are designed by selecting a combination of tower sections that come in 8'-long pieces. Tower section face widths currently range from 35" to 11". Heights does not endorse using more then three sections (24') of any particular width before tapering to the next width. The combination of tower section face widths and tapered design give the tower its strength.

While this review will focus only on the Heights tower with tapered sections and a hinged base, it is interesting to note that the company also can provide other types. You can get a crank-up telescoping unit in up to 34 variations, or you could opt to use a foldover kit on the tapered model, with or without the standard hinged base.

For my new QTH, I selected an 88' tower rated at 22SF. This model consists of three 30" sections, three 26" sections, three 22" sections, and two 18 " sections. This is a pretty substantial tower, and you can be prepared to pay more for an aluminum tower than for a steel unit. I felt it was worth the higher initial price to achieve the long life and low maintenance of aluminum. Also, my experience with guyed towers has taught me that considerable work and expense goes into the guy system; this is often overlooked in comparisons of towers.

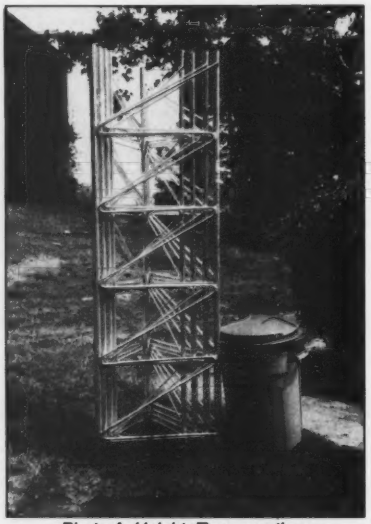


Photo A. Heights Tower sections.

Finally, ask your local metallurgical engineer about how steel sections snap but aluminum sections bend when they fail.

The sections come from Heights nestled into bundles, as shown in Photo A. I had expected to receive 11 separate tower sections off the truck at delivery, but instead only three bundles were off-loaded. This makes it easier to ship, and protects the inner tower sections. I did have one outer section get bent in shipment by the freight company where a bundle was obviously dropped on its end. A lesson learned: Trucking companies are totally unfriendly about damage claims unless you inspect the shipment and note any damage at the time of delivery. Calling them the next day will not work. As a result of this problem, Heights has changed its trucking company and has also designed a brace to protect the outer section while in shipment. This was one of many instances where Heights was highly responsive to customer input. (Be sure to ask them to brace your order for shipment.) The sections come in either straight, tapered, or top designs. For example, my first three sections consist of two straight 30" units and a 30" taper unit to transition to the next 26" straight section. As you can also see in Photo A, the tower sections all use a "Z" brace. This makes climbing very easy and "foot friendly," compared to the bracing used by several other tower manufacturers. Tower section sizes and data are given in Table 1. The tower sections are double-bolted together with steel hardware; you can also order a hardware upgrade from Heights which provides stainless steel nuts and bolts. I used all stainless steel hardware, and highly recommend this option. After all, why buy a rust-free tower and build it with nuts and bolts that can rust? After swallowing the initial cost of the tower, this upgrade is really a minimal cost option.

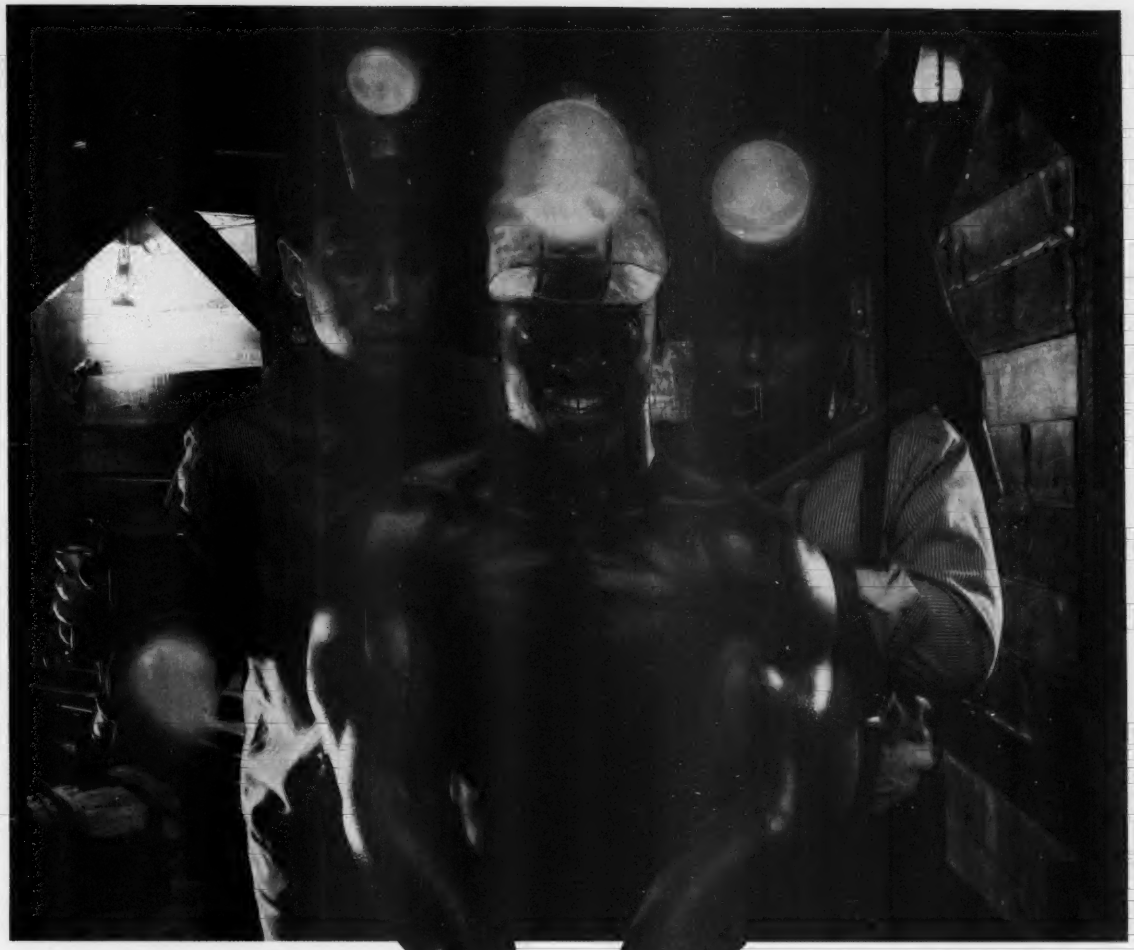
The supplied tower hinged base gives you the option of either building the tower on the ground and hinging it up, or building it section by section. The hinged base assembly is available in either heavy-duty steel or in stainless steel. I chose the stainless steel, and felt the slight additional cost was well worth it. Heights does not provide the hinged base in aluminum in order to avoid corrosive effects; concrete and aluminum do not like each other.

With the base also comes a set of three very hefty steel legs for setting into the concrete pad. The legs come with disks welded on to increase their anchoring ability in the concrete. The legs are not hot-dip galvanized, so you will need to spray a cold galvanizing onto the exposed leg parts after the tower is installed.

I decided that since the base legs are hollow, I wanted to provide a drainage path to protect against freezing. Each leg bottom goes into a 4" plastic drainage pipe which is used as a form and is filled with pea gravel to above the bottom of the leg. Photo B shows the hinged base and leg top after the concrete base pad is completed, but before applying the cold galvanizing.

I did not buy a top section with a mast collar tube section; instead, I used a standard straight section at the top with a top shelf. Heights offers both top shelves and rotor shelves, and will obligingly custom drill them for your bearing and rotor if you provide the data with the order. You can also obtain a variety of aluminum mast from Heights; I bought a 16' long piece of 2" o.d. tubing with a 1/4" wall thickness with my tower, since it could be included with the freight charges and tower.

Photo C shows the top shelf on the 18" top section. Heights originally provided a top shelf that was built similar to a rotor shelf and used a single bolt in each leg. After conferring with them, I specified a design which covered the tower legs and used two bolts in each leg. When they promptly made the new top shelf, they also drilled it for the thrust bearing I



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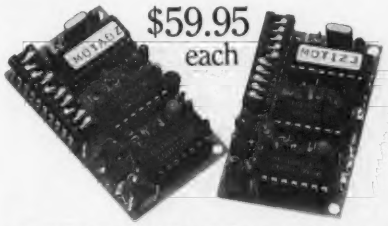

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planned to use. This top shelf is now their standard design.

At the time of my order, Heights could not provide a sufficiently heavy-duty thrust bearing, so I obtained a Rohn TB3 from a dealer and sent it to Heights for their top shelf drilling. Heights can now supply several very nice thrust bearings. Incidentally, thrust bearing eagle-eyes will note four extra bolts on this bearing. These are temporarily inserted as my own modification to prevent antenna rotation while performing maintenance on the rotor; thrust bearings do a wonderful job of turning in the wind when you do not have the mast clamped in the rotor. When you specify the top shelf drilling to Heights and are planning to use a thrust bearing with a 2" mast, I recommend having them drill the top shelf hole 2-1/4" in diameter to allow for alignment and to let the thrust bearing decide the mast center above the rotor. Heights was very cooperative and responsive to my needs for both the top shelf and a rotor shelf that needed non-standard holes. Of course, the hardware is available in optional stainless steel, including the U-bolts for the rotor shelf.

Making the Concrete Base

If you've never done a self-supporting tower before, you are in for a big surprise when it comes to preparing the concrete base. The base provides all the strength for a self-supporting tower, and it must be done right. For my tower, Heights recommended at least a hole 5' x 5' x 5', and needing 4.6 cubic yards of concrete. I usually do things a bit conservatively, and my base hole was bigger: I poured seven cubic yards. After hearing the outlandish quotes from several local concrete contractors, I went ahead and did the entire project myself at about half the cost. Digging the hole takes a lot of work when using a shovel and wheelbarrow, so don't rush yourself.

After the hole is ready for swimmers, a reinforcing steel bar cage is needed. I've never seen anything harder to cut than those bars! Carbide hacksaw blades bounce off alloy steel bars, so have several blades ready. Keep the rebar at least several inches away from the tower legs to keep lightning from fracturing the base and then dropping your tower.

I did not think I could do the job myself at first, but taking things carefully one at a time without rushing did finally result in a level, framed form ready for pouring. I do recommend buying the special framing nails for your lumber forms, along with the framing stakes from the local hardware store. The tower will be level if you prepare the base legs with the first tower section attached, and temporarily guy this section. Guying an 8' tower may sound silly, but the last thing you want is for those seven yards of wet, heavy new concrete to move the legs or tower out of alignment when the concrete is being poured into the hole.

Photo D shows the formed base ready to pour the concrete. Note that you will have to shore up the first tower section with some lumber to keep the base legs at the proper height. I recommend using a 1" x 2" piece atop each form top and below the shoring lumber to allow access to the freshly poured concrete when you want to finish the top concrete surface.

Proper grounding of the tower is done by running #4 gauge solid copper wire from each leg to three ground rods 8' long and 5/8" thick about a foot out from the concrete, then connecting each ground rod to each other and to the shack ground. The tower legs needed larger ground clamps than the local hardware store could supply, but I found that the Polyphasor Model J-2 clamps could fit easily. Be sure to make no sharp bends in any ground wire; lightning follows a straight line and does not like curves. I definitely do not advise skimping on materials here; your grounding system is vital to the health of the tower, antennas, radios, and your house.

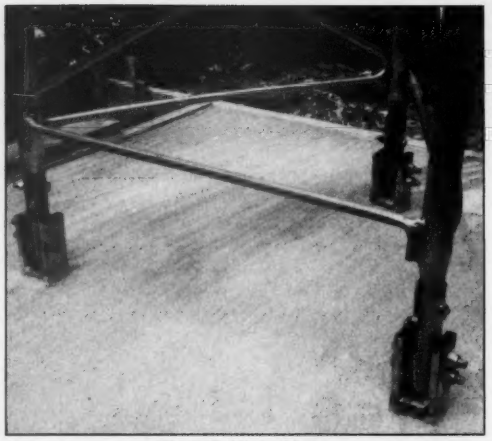

Photo B. Hinged base.

Final Construction

Now that you've paid for the tower, dug the hole, paid for the concrete, installed the ground system and rested—you can build the tower. I did it section by section instead of hinging the tower up from the ground. My biggest shock came when I went to use my trusty Rohn gin pole. Guess what? The Heights tower tubular legs are a lot bigger than either Rohn 25 or 45 tower legs, and my gin pole clamp would not fit. Here's where the low weight came in very handy. My-13-year-old son (N8QER) and I simply pulled each section up by hand with a rope, then planted the new section on the one below. Even the biggest 30" sections weighed only 45 pounds, compared to a higher steel tower section. Also, the 8' section length was much easier to handle than a 10' section would have been. Of course, the use of a quality safety belt by each tower worker is absolutely necessary. By the way, don't underestimate the amount of

Continued on page 61

Table One

Face Width	35"	30"	26"	22"	18"	14"	11"
Section Weight:	63 lbs.	45 lbs.	36 lbs.	30 lbs.	21 lbs.	14 lbs.	11 lbs.
Leg Diameter:	1.708"	1.625	1.5625	1.500	1.3125	1.0625	1.0625
Leg thickness:	0.204"	0.162	0.131	0.100	0.114	0.0962	0.0962
Z-Brace thickness:	5/8" solid	5/8" solid	9/16" solid	1/2" solid	7/16" solid	3/8" solid	3/8" solid

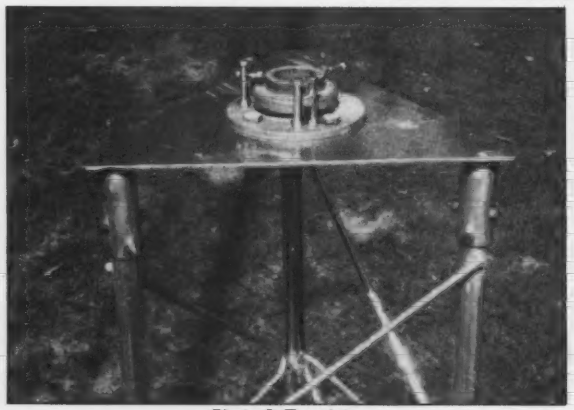

Photo C. Top plate.

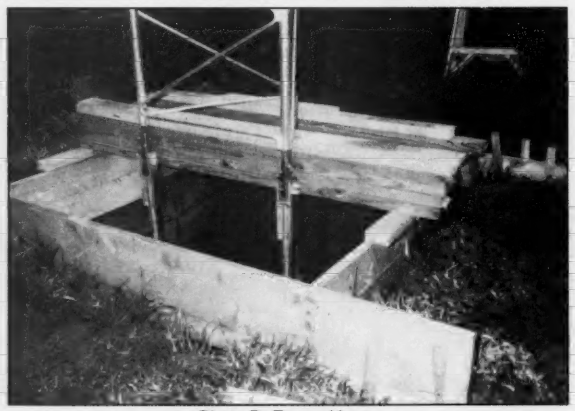

Photo D. Formed base.

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The PacTOR unit also supports AMTOR and RTTY operation making it ideal for all modes of HF operation. It will accept a call in either PACTOR or AMTOR and automatically respond in the correct mode. PacTOR commands are similar to packet commands and are easy to learn and use. Complete amateur callsigns are supported.

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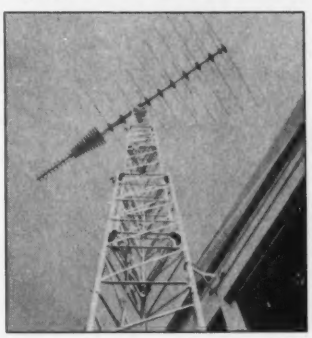

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SAREX Activity on STS-45

The Shuttle Amateur Radio Experiment (SAREX) activity on STS-45 lived up to its billing as a more informal operation with time for unscheduled 2 meter contacts with hams on earth. Most of the activity during the early days of the mission was dominated by school contacts, but after successfully completing many scheduled QSOs, the last days provided many with a chance for an informal quick contact.

The shuttle *Atlantis* was used for the ATLAS-1 (Atmospheric Laboratory and Applied Sciences) mission. Four of the seven astronauts of STS-45 were hams. The most heard callsign was that of mission specialist Dave Leestma N5WQC. Kathy Sullivan N5YYV was quite active with ham activity toward the end of the flight using Dave's call on a downlink of 145.55 MHz. Pilot Brian Duffy N5WQW and payload specialist Dirk Frimout ON1AFD were also monitored on 2 meters. When making private or school contacts on unpublished downlink frequencies, the astronaut-hams used their own calls, but primarily employed Dave's on 145.55 MHz. Future missions will use the call W5RRR/S to avoid callsign usage questions.

QSLs for STS-45 reception reports or contacts should be sent to the Sterling Park Amateur Radio Club, P. O. Box 599, Sterling VA 22170. Include a business-size envelope (or larger) with your QSL. Be sure to note the date, time and signal report on the card. Write on the outside of your envelope "STS-45 QSL 2-way" for QSO confirmation or "STS-45 SWL" for signal report confirmation.

The Poor Man's Satellite

Amateur television activity via balloon has been featured several times in the "ATV" column and other articles in *73*. Although balloons are a great way to get television signals out to more observers, they also provide an opportunity to try telemetry systems and communication experiments.

OSCAR-1 went into orbit over 30 years ago. It sent the message "HI" in Morse code at a speed related to the temperature of the on-board electronics using a 140 mW 145 MHz transmitter and a non-rechargeable battery. It lasted for a few weeks until its reentry.

Using the idea of OSCAR-1 as a guide and inspiration, the South Texas Balloon Launch Team sent a ham radio package to over 100,000 feet in late 1990. The FM transmitter was crystal controlled, with 100 mW output on 2 meters. A simple CW message generator with an analog signal mutiplexer sent tones representing the outside temperature and atmospheric pressure along with an identifying callsign. The speed of the code could be measured to determine the inside temperature. After an exciting chase, BLT-1 was retrieved Texas-style by shooting it out of a tree northwest of Houston. Its components were carefully checked and saved for future missions.

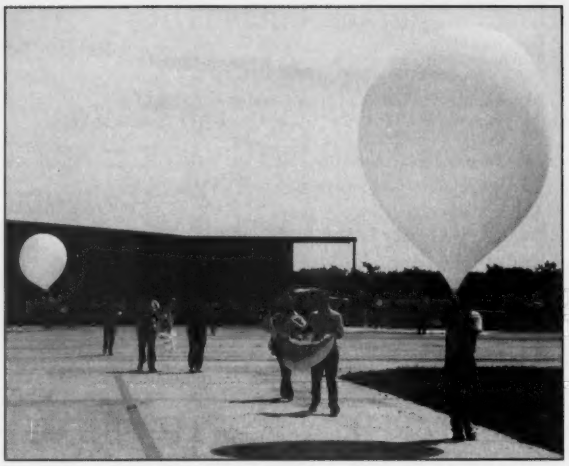

Photo A. The South Texas Balloon Launch Team (BLT) prepares to simultaneously launch two separate balloon payloads, BLT-5 and BLT-6. Photo by N5LCO.

Photo B. Mike Scarcella WA5TWT holds BLT-6 just prior to takeoff. BLT-6 contained a packet digipeater and telemetry system operating on 144.290 MHz. Also carried aloft were a series of CW beacons on 188.05 kHz, 28.437 MHz and 10.485 GHz.

Since that first balloon launch the group has focused on ATV from the edge of space. Telemetry became a secondary issue until April 4, 1992, when BLT-6 went up.

The group of the Houston-area balloon team grew in both size and ideas. After more launches involving video and packet digipeater efforts in 1991, it was apparent that there were more interesting experiments than room and weight constraints would allow for future endeavors. The team decided to build two separate packages for a simultaneous two-balloon launch. One payload would be focused on video efforts while the other would include beacons, telemetry and communications.

BLT-5 carried a color vidicon tube connected to a 1.5-watt PC Electronics ATV transmitter on 439.25 MHz. The antenna was a small helix aimed down. An automatic video switcher and ID screen from Elktronics were added along with a digital voice storage system and radio-controlled camera aiming system. Payload master for BLT-5 was Tony Summerville N5RPQ.

BLT-6 carried an array of beacons, a telemetry system, a 35mm camera, a

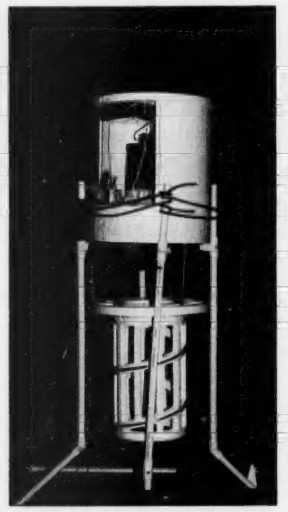

Photo C. Mike WA5TWT makes a final adjustment to the BLT-5 payload. This system carried a color vidicon TV camera, a video identifier along with a digital voice ID on the TV subcarrier and a 28.322 CW beacon. The camera view could be changed via a R/C pointing mechanism. A 2-turn helix (shown below the main package) was used for the 70cm ATV downlink.

```
WB5HLZ-6*>BLT-6:
Pressure= +07.211 in.Hg Inside Temp.= +070 F Outside Temp. -030 F
WB5HLZ-6*>BLT-6:
1183.2 1711.6 2572.5 6676.8
N5SHL>WB5HLZ-6*>WA5ZIB-1 [C]
WA5ZIB-1*>WB5HLZ-6>N5SHL (UA)
N5SHL>WB5HLZ-6*>CQ:
Henry at Austin, TX on 04-Apr-92 11:42 CST
WD5GAZ*>WB5HLZ-6>WALTER:
hi from walter in houston..
WB5HLZ-6*>BLT-6:
Pressure= +06.685 in.Hg Inside Temp.= +067 F Outside Temp. -037 F
WB5HLZ-6*>BLT-6:
1165.7 1727.7 2611.1 6699.2
WB5HLZ-6*>BLT-6:
To The Edge of Space.
KG5OA>WB5HLZ-6*>N5SHL:
This is Doug From Fort Worth
N5DDN>WB5HLZ-6*>BUDDY
Tasting, Tasting, 1,2,3..."Buddy"...Shreveport, LA
```

Figure. Sample of the April 4, 1992 BLT-6 packet output as received by Tom K5SAF in West Houston.

Photo D. The view from 62,000 feet. This photo was taken from the 35mm film camera attached to BLT-6. Lake Conroe (18 miles long) is shown in the foreground and Lake Livingston can be seen in the distance.

PacComm Umpad-3 Terminal Node Controller (TNC) and a 2 meter transceiver for the packet operation. Payload master for BLT-6 was Mike Scarcella WA5TWT.

The beacons transmitted CW on 188.05 kHz, 28.437 MHz and 10.485 GHz. The VLF and HF beacons sent identifiers and atmospheric pressure readings every minute at 10 wpm. Other telemetry, including inside and outside temperature along with readings from a light-diffusion sensor experiment, were sent via unconnected packets through the Umpad-3 and transceiver on 144.29 MHz.

Most of the simple pressure and temperature measuring system incorporated in BLT-1 was used in conjunction with a small computer designed by WB5TTS to measure the frequency of the analog audio tones for the BLT-6 telemetry. Formulas for decoding the data and adding text before sending the results over the air as packets were incorporated in the software. The plain text format allowed stations involved in contacts an opportunity to monitor the on-board sensors while chatting via the digipeater. The Figure shows a small sample of the activity and data monitored during the flight.

The BLT-6 package was spotted high in a pine tree northeast of Conroe, Texas, a few hours after parachuting back after the balloon burst. A small audio beeper aided the recovery group when RF direction finding became difficult. Once again, it was necessary to shoot the payload down Texas-style with rifles. BLT-5, however, is still missing somewhere in the woods about 15 miles east-northeast of Willis, Texas. Extensive ground searches and spotting efforts by Dave K5ERP in a small plane have proved fruitless in the quest for the payload. A cash reward has been announced for the finder of that package.

The Balloon Launch Team of South Texas is currently investigating further experiments with ATV, telemetry and possibly a Mode A (2 meters up and 10 meters down) linear transponder like the RS satellites for future flights.

Why Launch Balloons?

In addition to the opportunity to experiment with telemetry, there are other reasons for launching an amateur radio package on a balloon. It is an activity that requires group participation in a fun and challenging program. It requires the participants to learn rudimentary meteorology in order to predict the balloon's path. Direction finding (DFing) is a key ingredient since the package represents the ultimate foxhunt. No one knows the location of the downed package. Designing equipment to survive the rigors of extreme temperature swings and operate in a potentially RF-rich environment can be a real challenge. Finally sending it all to the edge of space and getting it back intact is quite an experience.

In *The Satellite Experimenter's Handbook* by Martin Davidoff K2UBC, a chapter is dedicated to "So You Want to Build a Satellite." It's an incredible task. To design, build and launch an OSCAR (Orbiting Satellite Carrying Amateur Radio) requires years of work and a significant support group like AMSAT. Early satellite prototypes were tested on airplane flights over the East Coast and balloon launches in Germany. Our current hamsats have a history built on systems like those of the various organizations around the country now involved with balloon experiments. While the hamsat program provides ideas for balloon launches, the balloon flights also may provide new ideas appropriate for future orbiting payloads.

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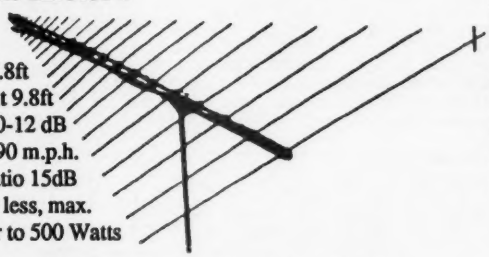

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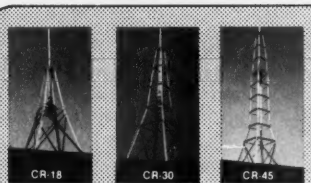

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ELNEC Version 2.2

An updated version of the antenna modeling program.

All computer software undergoes updating from time to time, and ELNEC (first introduced in 1990) is no exception. With the updating come new features and easier operation.

What is ELNEC?

ELNEC is an easy-to-use implementation of MININEC (a comprehensive antenna modeling program developed by the Naval Oceans Systems Center). Easy implementation, in this case, means a menu-operated program with an easy-to-understand x-y-z coordinate system for telling the computer the physical design of an antenna.

The output of the program is a graphic display of an antenna's radiation pattern (ARRL-type grid style) on screen or to a printer.

Tabular formats of output are available for those who don't want visual presentations. However, a picture is worth a thousand words.

The outputs, graphic and tabular, show forward gain, beam width, front-to-back ratio, side lobe, SWR, voltage, current, and source impedance. You can indicate 3 dB bandwidth points directly on the graphic plot by selecting the "on screen analyze" feature.

The Improved ELNEC

When I first reviewed ELNEC I was disturbed by the fact that I had to recalculate each time I wished to review a previous antenna design. The new version 2.2 allows you to save files of any antenna calculated for later recall. This is really great, particularly for those complicated designs that take hours to complete on an XT.

The improved menu requires you to strike two keys before any action is taken. This allows for logical letter selections for each action, ie: FR for frequency (see Figure 1).

Radiation plots can be selected to show vertical, horizontal, and total patterns (see Figure 2). However, it is the total pattern that interests users most. ELNEC can be set to display the total pattern only

Entering the description of an antenna requires building a table of information based upon its dimensions. A simple x,y,z coordinate system is used (see Figure 3).

The source (of radio energy) is entered by telling the system its physical location. Source information is entered as a percentage of the fed element's length, requiring no pulse counting of the entire antenna.

The output of ELNEC is in text or graphical form (see Figure 4).

Source data is available for indicating various factors of the antenna including voltage, current, impedance, and power. Calculated SWR is shown as part of the source data (see Figure 5).

The new feature I feel to be the most significant is the ability to view an antenna. This provides a graphical depiction of the front, top, and right side of the antenna (see Figure 6). Sources and loads are also shown. This graphic display of an antenna you have entered in coordinate format is essential to preventing mistakes. For example, on a multi-element loop design I was working on I had erred in the wire entry section, thereby deforming the antenna. If I had not been able to view the antenna in its graphical form, the computed outputs would have been for what I had entered, not what I wanted. A visual check of antenna design work can save loads of time in correcting errors.

A Glitch of MININEC

Note that glitch applies to MININEC—therefore it includes ELNEC and any other MININEC-based system. I have found that the dB gain figures displayed in the lower left of the pattern plots can be misleading. These figures are based upon gain over the theoretical

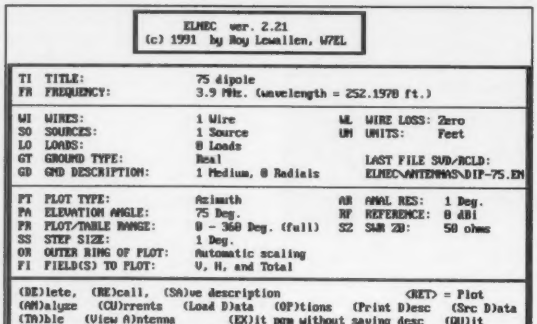
ELNEC ver. 2.21
(c) 1991 by Roy Lewallen, W7EL
TI TITLE: 75 dipole
FR FREQUENCY: 3.9 MHz. (wavelength = 252.1970 ft.)
WI WIRES: 1 Wire
SO SOURCES: 1 Source
LO LOADS: 0 Loads
GT GROUND TYPE: Real
GD GND DESCRIPTION: 1 Medium, 0 Radials
WL WIRE LOSS: Zero
UN UNITS: Feet
LAST FILE SVD/RCLD:
ELNEC\ANTENNAS\DIP-75.EN
PT PLOT TYPE: Azimuth
PA ELEVATION ANGLE: 75 Deg.
PR PLOT/TABLE RANGE: 0 - 360 Deg. (full)
SS STEP SIZE: 1 Deg.
OR OUTER RING OF PLOT: Automatic scaling
FI FIELD(S) TO PLOT: V, H, and Total
AR AMAL RES: 1 Deg.
RF REFERENCE: 0 dBi
SZ SWR ZO: 50 ohms
(DE)lete, (RE)call, (SA)ve description <RET> = Plot
(AN)alyze (CU)rrents (Load D)ata (OP)tions (Print D)esc (Src D)ata
(TA)ble (View A)ntenna (EX)it pgm without saving desc (QU)it

Figure 1. New menu requiring a double keystroke before action. For example, the letters "Q" and "U" must both be pressed before the program will quit back to DOS.

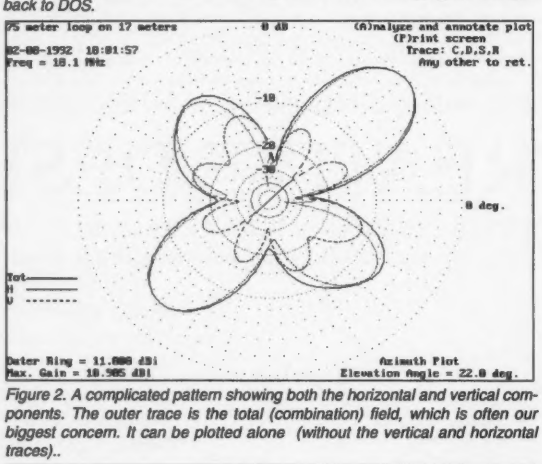

Figure 2. A complicated pattern showing both the horizontal and vertical components. The outer trace is the total (combination) field, which is often our biggest concern. It can be plotted alone (without the vertical and horizontal traces)..

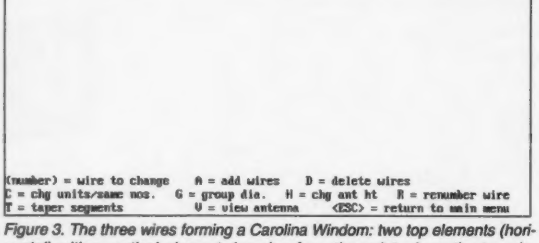
WIRES
Wire Conn. End 1 (x,y,z : ft) Conn. End 2 (x,y,z : ft) Dia(in) Seg.
1 -100.00, 0.000, 40.000 W2E1 0.000, 0.000, 40.000 # 12 20
2 W1E2 0.000, 0.000, 40.000 85.000, 0.000, 40.000 # 12 20
3 W1E2 0.000, 0.000, 40.000 0.000, 0.000, 10.000 # 12 20
Tot segs: 60
(number) = wire to change A = add wires D = delete wires
C = chg units/same nos. G = group dia. H = chg ant ht R = renumber wire
T = taper segments V = view antenna <ESC> = return to main menu

Figure 3. The three wires forming a Carolina Windom: two top elements (horizontal) with a vertical element dropping from the point where the top elements join. It could be described as a lop-sided letter T.

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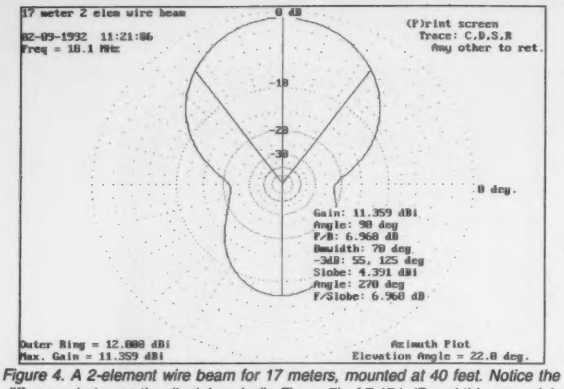

Figure 4. A 2-element wire beam for 17 meters, mounted at 40 feet. Notice the difference between the dipole's gain (in Figure 7) of 7.174 dB and this example's 11.359 dB.

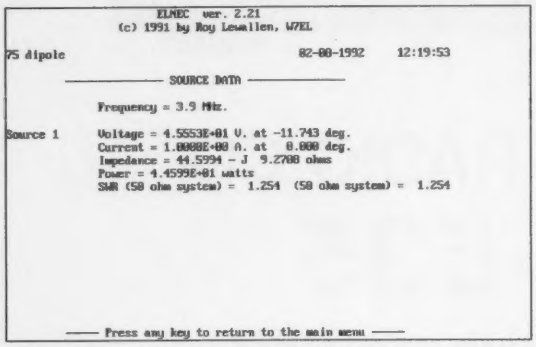
ELNEC ver. 2.21
(c) 1991 by Roy Lewallen, W7EL
75 dipole
02-08-1992 12:19:53
SOURCE DATA
Frequency = 3.9 MHz.
Source 1
Voltage = 4.5553E+01 V. at -11.743 deg.
Current = 1.0000E+00 A. at 0.000 deg.
Impedance = 44.5994 - J 9.2708 ohms
Power = 4.4599E+01 watts
SWR (50 ohm system) = 1.254 (50 ohm system) = 1.254
Press any key to return to the main menu

Figure 5. Source data for a 75 meter dipole includes the calculated SWR.

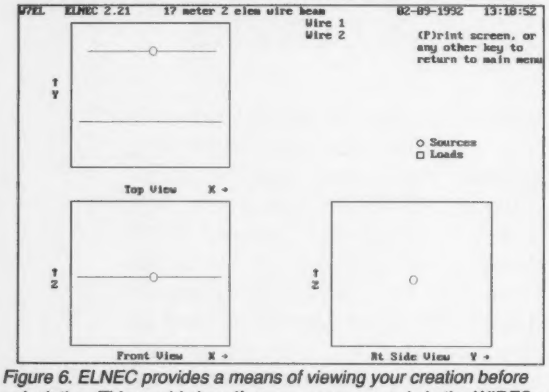

Figure 6. ELNEC provides a means of viewing your creation before calculating. This would show if any errors were made in the WIRES or SOURCE data.

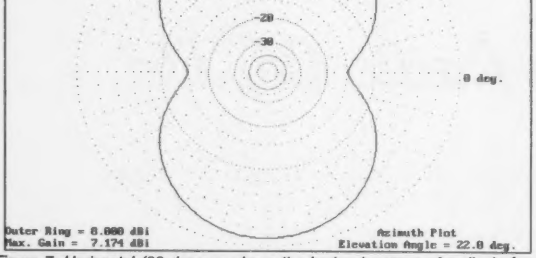

Figure 7. Horizontal (22 degrees above the horizon) pattern of a dipole for 17 meters mounted at 40 feet.

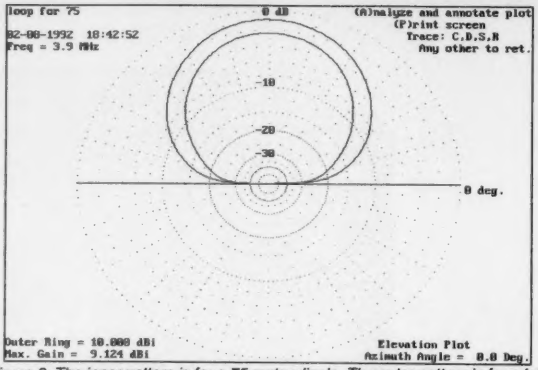

Figure 8. The inner pattern is for a 75 meter dipole. The outer pattern is for a full-sized 75 meter loop at the same height. Note the loop's gain of nearly 2 dB.

isotropic antenna and tend to be very optimistic.

For my purposes, I have always compared my designs with a standard dipole located in a similar position. The gain difference between the new antenna and the dipole indicates whether or not the design is viable (see Figures 4 and 7).

Comparing Designs

With the new ELNEC, previous calculations and plots can be saved for future use, allowing the user to super-impose the plot of other designs over a current plot. For example: In exploring the feasibility of using a full-sized 75 meter loop versus a dipole (at the same locations), I plotted the loop, then recalled the dipole pattern (see Figure 8).

Who Uses ELNEC?

Most hams are interested in antennas and how well they work. ELNEC provides a means of graphically seeing this work and allows the user to make new antennas, or change old ones, to suit his needs.

"With the new ELNEC, previous calculations and plots can be saved for future use, allowing the user to super-impose the plot of other designs over a current plot."

An entire antenna farm can be designed with ELNEC, all during the cold winter months, then built in the spring. No "cut and try" here!

I have designed some interesting anten-nas and improved upon others by applying what ELNEC says. It is a program that most hams will enjoy and find useful. It is also sophisticated enough to provide analysis of complex designs. In other words, there is something here for everyone.

Availability

ELNEC operates in the DOS environment of "PC compatible," requiring a minimum of 360K RAM and a graphics video adapter (EGA Color is really nice). It will work with Epson or HP printers and those understanding similar commands (most do).

ELNEC comes in two specific versions: one for the computer equipped with a math co-processor and another for the plain computer. Be sure to order the correct version.

On the subject of math co-processors: If you are using an older XT or AT type machine I strongly recommend the use of a math co-processor. The increase in speed is very great and the cost should be little. In fact, the last co-processor I purchased for an XT cost me $25, a worthwhile investment.

ELNEC remains *without copy protection*, as all software should! I feel very strongly that no software should be copy protected, due to the technical problems such protection induces. 73

For additional background on ELNEC, see Bill Clarke WA4BLC's review on pages 52—54 of the January 1991 issue of 73 Amateur Radio Today.

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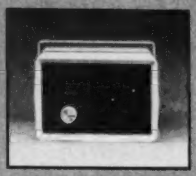

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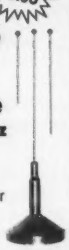

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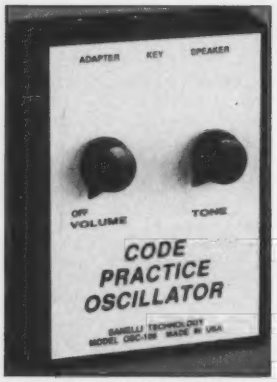
SANELLI TECHNOLOGY

Sanelli Technology has released a new code practice oscillator, the OSC-100. The OSC-100 outputs an extremely pure CW tone to an external speaker. It features separate volume and tone controls, jacks for an external 9-volt adapter, an external code key, and an external speaker. It will also operate from a 9-volt battery which is installed via the convenient battery door. It is perfect for individual or group code practice sessions.

The OSC-100 is enclosed in a durable black plastic case that fits in the palm of your hand. The faceplate resists wear and is easy to clean. The OSC-100 is priced at $39.95 plus $5 S/H (CO residents add sales tax). For more information, contact *Sanelli Technology, P.O. Box 416, Kiowa CO 80117-0416; (303) 621-2534.* Or circle Reader Service No. 201.



OVERVIEW SYSTEMS

OverView Systems has introduced AMFAX-10, an AM-to-FM converter to enhance the capabilities of the popular AEA-FAX hardware/software package for IBM compatibles. The original AEA-FAX package can only process FM FAX images transmitted on the HF band. However, all-weather FAX images transmitted directly from the satellites are AM. Inserting AMFAX-10 between the appropriate receiver and the AEA-FAX interface allows the user to receive and display VHF polar orbiting, geostationary and GOES-TAP AM weather FAX images. The AMFAX-10 converter is a quality PCB housed in a 5-5/8" (w) x 3-1/4" (d) x 2" (h) almond colored ABS plastic case. It features a front panel brightness control, LED level indicator, 12-14 VDC operation, and a built-in switch to select original FM FAX or new AM FAX modes. The AMFAX-10 appears transparent to the AEA-FAX system, providing vivid weather satellite images using existing software. It is priced at $99.95 plus $6 shipping for the complete converter and user's manual. An optional 12 VDC adapter is available for $8.95. For more information, contact *OverView Systems, P.O. Box 130014, Sunrise FL 33313; (305) 748-8315 (evenings or weekends).* Or circle Reader Service No. 204.

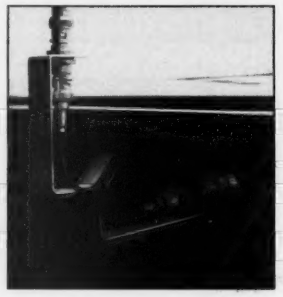
P.C. ELECTRONICS

P.C. Electronics has introduced a new 10-watt TC70-10 70cm ATV transceiver. Any code-free Tech or higher licensee can easily have his or her own ATV station with the TC70-10, camcorder, TV, 70cm antenna, coax and power supply. Aimed at those who want a rugged all-in-one-box unit for portable public service events or minimum operating table space in the shack, the rig is housed in a 7.5" x 7.5" x 2.7" black die cast aluminum box. The TC70-10 is a stand-alone 10-watt version, like the original TC-1, which was just the right power level for most users for local simplex and repeater work, providing snow-free video up to 90 miles line of sight with 14 dBd beams. New features include an internal variable sync tip power control (from to up to 15 watts PEP) and sync stretcher to allow proper driving of the Mirage D1010-ATVN or RF Concepts 4-110 to their full PEP (100 watts) output, without overdriving into sync or audio clipping, for the DXer. Separate volume controls are provided for a low impedance dynamic mike and line audio from a camcorder or VCR, which enables voice-over commenting while transmitting a home video tape. A video monitor output jack provides camera video for focus and lighting setup before transmitting, and true video RF detected at the final amp output in transmit for proper video gain adjustment. The unit comes tuned with one customer-specified transmit crystal and a socket and switch for an optional second crystal. The power supply requirement is 12 to 13 VDC at 3 amps.

The TC70-10 is priced at $499. For more information, contact *P.C. Electronics, 2522 Paxson Lane, Arcadia CA 91007; (818) 447-4565, Fax: (818) 447-0489.* Or circle Reader Service No. 205.

SIGN ON

SIGN ON produces removable callsigns designed to help protect valuable mobile radio equipment from theft in unattended vehicles. These 2-1/4" x 8" all-weather plastic magnetic or suction-cup mounted signs are designed for immediate application or removal and offer instant transfer from one vehicle to another. SIGN ON products feature the words "Amateur Radio" in addition to your callsign or favorite repeater frequency. Their easy-to-read signs may be ordered with background colors of black, blue or red; the lettering is white. When ordering, please specify magnetic (for exterior applications such as rear trunk) or suction (for interior rear window) mount. These signs are $9.95 each; two for $18. Club discounts are available. For more information, contact *SIGN ON, 1923 Edward Lane, Merrick NY 11566.* Or circle Reader Service No. 202.



TRIONICS

Trionics is now offering a power/charger (left)—a compact, versatile, rechargeable, portable power station that can supply 3, 6, 9 and 12 VDC from a 6.5 Ah safety-sealed lead acid battery. This unit is ideal for powering small amplifiers, mobile rigs, handhelds, camcorders, cellular telephones or other items in the field, and can be used as a vehicle or boat starter. This is a perfect item for emergency, Field Day, remote or portable operation needs. It can be recharged from either 115 VAC or 12 VDC power sources. The charger circuit automatically shuts off when the battery reaches a "full charge" condition. Recharge times are approximately three hours from 12 VDC or eight hours from AC. The unit features a voltage/charge meter to monitor output voltage and battery condition. The unit comes complete with a UL-listed AC charge adapter, a fused 12 VDC cigarette plug cordset and an accessory cord with multi-voltage adapters.

Trionics is also offering a new window antenna mount (right), Model BWM-1, designed to get the user's antenna out of the car and above most rooflines. This rugged metal mount fits onto the car or truck window for temporary mounting of hand-held antennas like the "rubber duck." The almost 4" height to the top of the connector is an aid in extending the range of the handheld's signal to local repeaters. The mount features a dual BNC type connector that allows the user to use his/her own coax or the optional Model BC 6-174, a 50-ohm, 6-foot, BNC-BNC, small coax cable.

The portable power station, Model CA180, is $79.95; the BWM-1 mount is $13.95; and the BC 6-174 cable is $10.95. The mount and cable are also available as a combined package for $23. CA residents add sales tax. For more information, contact *Trionics, P.O. Box 1434, Rancho Cordova CA 95741-1434; (916) 366-7408.* Or circle Reader Service No. 203.

HAMTRONICS

The Hamtronics line of VHF and UHF FM repeaters has been expanded to include some new models, including several new REP-200 Repeater options. For those who want to build their own repeater from a kit and save a little money, the full-blown REP-200 kit is now available for $1095. To make it easier, Hamtronics is supplying the control board all wired, tested and programmed. The user has to only build the RF modules and assemble the chassis. (The latter is a real treat because of the high quality aluminum chassis with RF-tight compartments welded in place and covers held on with captive nuts.) For hams who don't want autopatch, Hamtronics is offering the REP-200V Repeater in kit form with the COR-4 Controller instead of the microprocessor-based controller, for $795. The COR-4 has COR and CW ID features, but no DTMF or autopatch features. Another variation is the REP-200N ($695 kit, $995 wired and tested), with no controller, for hams who want to use voice ID and the other advanced features of an ACC-type controller. On this model, the connections from the RF modules terminate at feedthrough capacitors in the shielded compartments, allowing external controller connections to be made directly without having to buy or modify any existing controller board.

All of the above repeaters are available for 6 meter, 2 meter, 222 MHz, and 440 MHz ham bands, and they are FCC-type accepted for operation in the commercial hi-band and UHF band. Basic output power levels are offered from 10W to 25W, depending on frequency. Add-on PAs are also available.

For operation in the 902-928 MHz band, Hamtronics has a 10W model of the full-blown, wired/tested REP-200 Repeater for $1455. Add-on PAs are also available.

For more information or a full catalog, contact *Hamtronics, Inc., 65 Moul Road, Hilton NY 14468-9535; (716) 392-9430, Fax: (716) 392-9420.* Or circle Reader Service No. 206.

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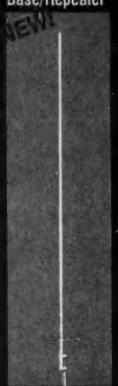
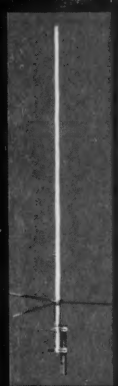
5/8 wave x 8
Max Power: 200 watts
Length: 17' 8"
Connector:
UHF (SO-239)



CA-2x4WX
Gain & Wave:
146MHz 6.5dB
5/8 wave x 2
446 MHz 9.0dB
5/8 wave x 5
Max Power: 200 watts
Length: 10' 2"
Connector:
UHF (SO-239)



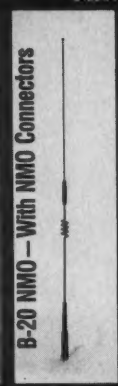
CA-2x4FX
Gain & Wave:
146MHz 4.5dB
7/8 wave
446MHz 7.2dB
5/8 wave x 3
Max Power: 200 watts
Length: 5' 11"
Connector:
UHF (SO-239)

CPR-5800
Gain & Wave:
146MHz 5.0dB
7/8 wave
446MHz 7.6dB
5/8 wave x 3
Max Power: 120 watts
Length: 5'
Connector:
UHF (PL-259)

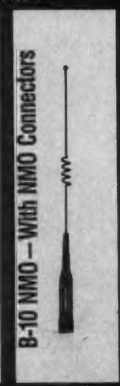
CPR-5400
Gain & Wave:
146MHz 3.5dB
1/2 wave
446MHz 6.0dB
5/8 wave x 2
Max Power: 120 watts
Length: 3' 2"
Connector:
UHF (PL-259)

CA-2x4MB
Gain & Wave:
146MHz 4.5dB
7/8 wave
446MHz 7.0dB
5/8 wave x 3
Max Power:
150 watts FM
Length: 4' 10"
Connector:
UHF (PL-259)

CA-2x4SR
Gain & Wave:
146MHz 3.8dB
5/8 wave
446MHz 6.2dB
5/8 wave x 2
Max Power:
150 watts FM
Length: 3' 4"
Connector:
UHF (PL-259)



B-20
Gain & Wave:
146MHz 2.15dB
1/2 wave
446MHz 5dB
5/8 wave x 2
Max Power: 50 watts
Length: 30"
Connector:
UHF (PL-259), OR
NMO (B-20 NMO)



B-10
Gain & Wave:
146MHz 0dB
1/4 wave
446MHz 2.15dB
1/2 wave
Max Power: 50 watts
Length: 12"
Connector:
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NMO (B-10 NMO)

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The NTSC ATV Repeater

Members of NTSC (the North Texas Synchronization Society) in the Dallas-Ft. Worth area have built a rather unique ATV repeater system. Located on a commercial TV tower (KTVT channel 11) at the 1270-foot level (AGL), the coverage around the area is tremendous. The NTSC group chose an output on 421.25 MHz (horizontally polarized) to make it easy for those who had cable-ready TVs or VCRs to tune in via cable channel 57. Since most of the commercial TV stations are located near the NTSC site, area residents with outside TV antennas already have their antennas pointed in that direction. As a result, its very easy for ATV newcomers, or those curious about the mode, to tune in to the action without having to buy specialized downconverters or antennas. A large viewing audience is possible since there are several hundred thousand people with horizontal TV antennas and cable-ready TVs in the region.

Doppler Radar

The NTSC system has access to a very fine Doppler radar system located in Corsicana. This radar is owned and operated by Weather Radar Warning System, Inc. The Doppler radar system is brought up during severe weather and is used to look for storms with tornado potential. Thanks to a grant from the Tarrant County Firefighters Association, NTSC was able to purchase the equipment necessary to bring the Corsicana radar output up into the Dallas-Ft. Worth region. This link consists of a TD systems CU-125 and a 10-watt 915 MHz FM-TV transmitter mounted in front of a Decibel Products DB-495 corner reflector antenna at 60 feet. The link covers a 45-nautical-mile path and is solid even when the heaviest of storms pass through the area. When not used for weather radar, the 915 MHz FM-TV frequency is used as the general user input to the ATV repeater.

FM-TV Input

Since the input uses FM-TV, the method of switching between the weather radar and general purpose users is rather unique. The repeater receive antenna for the weather radar is a *vertically* polarized corner reflector. The general user input antenna is an 8-bay zig-zag omni-directional *horizontal* antenna built by Steve Franklin WB5KGL. To change the feed between general purpose users and the weather radar, a touch-tone command causes a relay to switch in one of the antennas. The capture effect of FM-TV allows the weather radar to run continuously without interfering with local users.

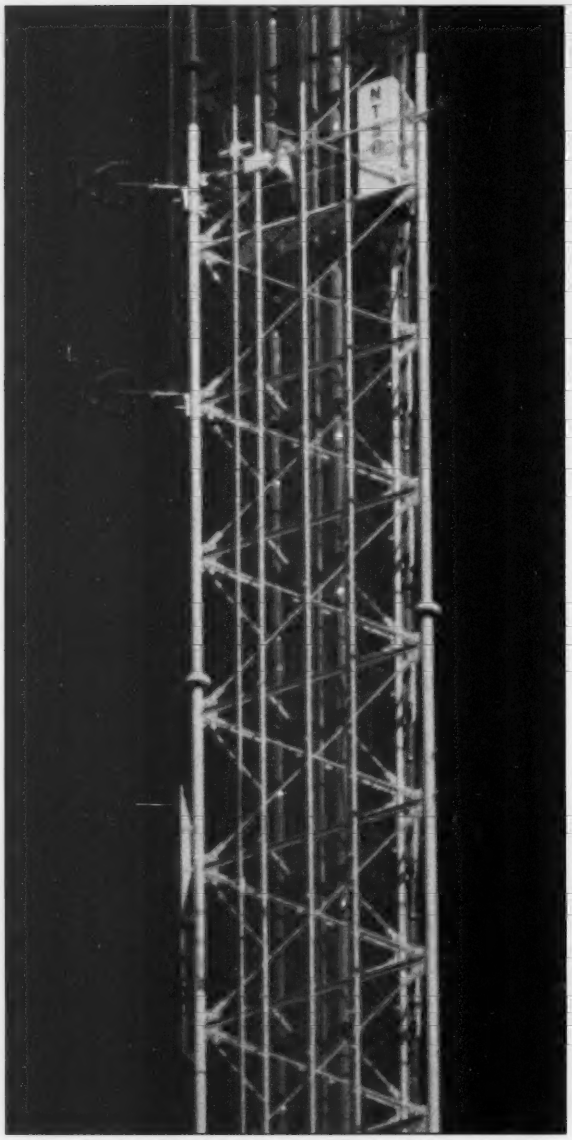

Photo A. The NTSC ATV repeater is situated at the 1270-foot level of a commercial TV tower near the Dallas-Ft. Worth area. Photo taken by Robert Skegg VE7AII/W5 through a high-power lens.

The Transmit Chain

The 421.25 MHz ATV transmitter system consists of a 2-watt exciter built by Steve Franklin WB5KGL, A Mirage D-100ATV, a 7-pole indigital filter built by Arlyn Stewart AA5BY, a pair of cavities donated by Andy Carstarphen WY5V and 45 feet of 1/2" Heliax and connectors donated by Merle Taylor WB5EPI.

The antenna array (constructed by Harold Reasnor K5SXK) consists of four horizontally polarized dipoles placed in a staggered arrangement down the face of a 6-foot-long, 6" diameter section of coaxial transmission line donated by Sandy Sandberg N5NBW. The staggered arrangement of the dipoles achieves a cardioid type pattern that favors the west, north and south. This pattern was chosen to avoid the possible multipath effects of the side-mounted antenna and to con-

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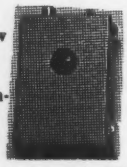

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centrate the most signal towards the largest viewing area. Even with a null almost straight south, the repeater has been seen as far south as Waco (70 miles away).

The 915 MHz FM-TV Receive System

The 33cm receive system consists of a high-level downconverter, a SAW type IF filter and a 70 MHz FM demodulator. The downconverter was specially built to withstand the high RF environment at the repeater site. The repeater is co-located with two commercial TV transmitters (KTVT channel 11 and KERA channel 13, as well as KERA-FM and KEGL-FM). With this concentration of RF energy, camcorders and most film cameras don't function and attempts to photograph the equipment rack sometimes results in a camera with fried electronics. Photo A, showing the ATV repeater in place at the 1270-foot level of the tower, was taken from a half mile away through a high power lens.

The 1277.25 MHz Input

The 23cm input accepts regular AM-TV signals. The receive antenna is an omni-directional, horizontally-polarized, Alford slot built by K5SXK and K5BYS. Forty-five feet of Heliax (donated by Merle Taylor WB5EPI) feeds into the repeater cabinet. The downconverter/demodulator was built by Steve WB5KGL.

Control

The video inputs are selected by touch-tone commands through use of a controller built by John Holmes WA5WXA. The unit has four video and audio inputs and two video and audio outputs. Output relays are provided for keying transmitters, switching antennas and other control functions.

Activity

There are always a number of active users in the region. During space shuttle missions, the system also transmits the NASA Select video. During severe weather, the Corsicana Doppler radar has been an invaluable aid to storm spotters and the the National Weather Service office in Ft. Worth. It seems that the NWS was not able to see the Corsicana radar feed in the past and had to actually use an FM voice link to have the radar operator describe what he was seeing on the display. The NWS now has an ATV downconverter and, for the first time, can actually SEE the display via the NTSC repeater!

Several storm spotters are gearing up to go ATV mobile so they can relay

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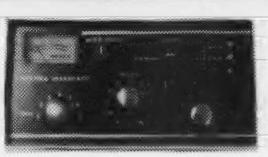

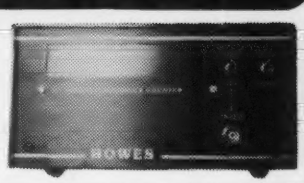

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Photo B. The NTSC logo and repeater test pattern.

Photo C. In the WY5V/N5LLF hamshack. (l to r): NTSC president Andy Carstarphen WY5V, Thurman "Camcorder Curly" Ganey N5SFQ and vice-president and program director David McNeil KI5VM.

live storm spotting and on-site damage assessment via the NTSC repeater.

There has also been some successful experimentation with airborne ATV. A recent helicopter flight yielded P5 pictures from 35 miles out from a 10W transmitter and a pair of stacked nanowheel antennas built by Dave Clingerman W6OAL of Olde Antenna Labs in Denver, Colorado. This antenna array was specially designed for NTSC for aircraft use and was wind tunnel tested to 200 knots.

Most users can access the ATV repeater using 1-watt transmitters (antenna-mounted) if they live within 30 miles. Beyond that point 10- or 20-watt stations are needed. There is also a 2 meter FM receiver located at the repeater on 144.340 MHz. This frequency is used for coordination of ATV activity in the Dallas-Ft. Worth area. The audio received by the repeater on 144.34 can be mixed in with the ATV subcarrier (or even on-carrier for special occasions) so anyone watching the repeater can hear the activity. This makes round-table conversations very easy and encourages receive-only stations to participate.

Co-Existing on the 900 MHz Band

Some final notes for those interested in using FM-TV. The NTSC group highly recommends the use of FM-TV and the use of the 900 MHz band in a repeater installation or link. Their "narrow-band" (as compared to wide-band satellite TV transmissions) FM-TV signal occupies just a little more bandwidth than a double-sideband AM transmission.

Also, there is a Teletrac vehicle locating system on the air on the 900 MHz band in the area. By careful choice of frequencies, mode of emission, polarization and power, the NTSC group was able to successfully live with their spectral neighbors. In fact, when they approached the Teletrac people recently to introduce them to the NTSC system, they weren't even aware of the NTSC presence on the band. It appeared that the vehicle location systems have more problems with interference from part 15 devices than with the much higher power amateur transmissions.

Future additions to the NTSC repeater may bring a selectable FM-TV input/output on 1248 MHz and an FM-TV output on 2434 MHz.

Photo E. Using just 10 watts, Charlie Kilgore N5MYG puts in a P5 signal from a distance of 72 miles.

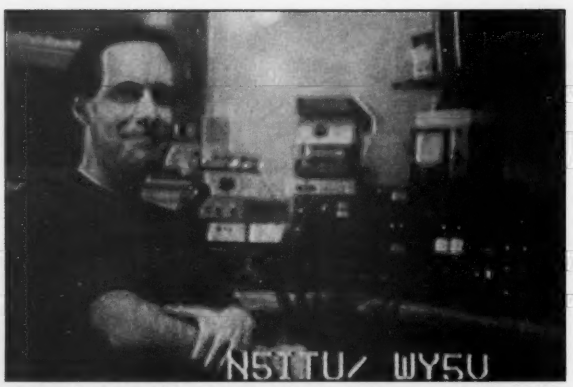

Photo F. Weather satellite enthusiast Jeff Wallach N5ITU works the repeater from a distance of 28 miles on 915 MHz FM.

Photo D. Ron Jackson N5OJT works through the repeater via the 915 MHz FM input.

Join in the Fun

If you live in the Dallas-Ft. Worth area or are just passing through, you're welcome to tune in to the system. The repeater output is up and running most of the time. Just give a call on 144.34 and one of the members should hear you. There is an ATV net every Wednesday evening at 8:30 p.m. on the 147.14 (+600) Arlington repeater as well as the NTSC ATV repeater.

Andy WY5V maintains a telephone number for NTSC for those wishing more information. The NTSC hotline is (214) 289-WY5V. You can also write to Andy Carstarphen WY5V, c/o NTSC, Inc., 1409 Wesley Dr., Mesquite TX 75149-5667. 73

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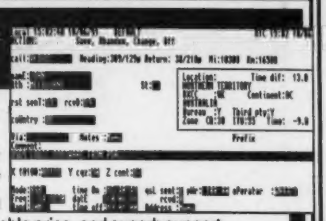

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SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event. Check /HAMFESTS on our BBS (603-924-9343) for listings that were too late to get into publication.

JUN 1992

NEWMARKET, ONT., CANADA The York Region ARC is sponsoring the YRARC National "Young Amateur of the Year"Award to help promote the hobby of amateur radio among the youth of Canada. The prize offered to the winner of this award is $500. First and second runners-up will receive $200 and $100 respectively. Submissions for the award will be welcomed from any official of an affiliated CARF or CRRL Club throughout Canada. Details of the candidate, his or her age and accomplishments in the field of ham radio, are the basis for the judging. Candidates must hold a Canadian amateur radio license and be a Canadian resident. Good quality photographs of the candidate will be a definite advantage. Submissions, including details of the sponsor and sponsoring club, should be forwarded before Aug. 31, 1992 to ***Attn: Awards Committee, The York Region Amateur Radio Club, PO Box 352, Newmarket, Ont., L3Y 4X7, Canada.*** The awards will be presented in November at the York Region ARC Hamfest. For more info, call ***Mr. Andrew Betterton VE3ORE, (416) 895-8710.*** All awards are made at the discretion of the YRARC.

DICKINSON, ND The Theodore Roosevelt ARC will sponsor a "North Dakota Worked All Counties" certificate, beginning immediately. The certificate is available to Ham and SWL enthusiasts. At this time there is no date set for discontinuation. For an application form, send a #10 SASE to ***Steve Allar N0ELA, 1701 6th Ave. NE, Beulah ND 58523.***

JUN 6

ALAMOGORDO, NM The Alamogordo ARC will sponsor VE test sessions at 12 noon. Persons already holding an amateur license and wishing to upgrade must bring their original license and CSCE (if any), and a copy of both. Talk-in on 146.80, down 600. For info, contact ***Ole WA5IPS, (505) 437-5896; or Larry WA5UNO, (505) 437-0145.***

SOUTH BURLINGTON, VT The Radio Amateurs of Northern VT will sponsor the Northern Vermont Summer Hamfest and Computer Technology Fair from 8 AM-3 PM at the South Burlington Middle School Complex, Dorset St., off of I-89 exit 14-E. Indoor/outdoor Flea Markets. Close proximity to shopping malls. VE Exams will be given at 2 PM. Admission $3, free for under 18 years. No charge for flea market spaces. Tables available. Talk-in on 146.25/.85. Hamfest contact: ***N1DMP, (802) 893-6458.*** Exams contact: ***WB2JSJ, (802) 879-6589.***

JUN 7

PRINCETON, IL The Starved Rock RC Hamfest will be held at the Bureau County Fairgrounds, starting at 6 AM. Advance tickets $4 (before May 20th) and $5 at the gate. Free camping and outdoor Flea Market area. 8' tables indoors are $10 ea. Talk-in on 146.355/.955. Contact ***Bruce Burton KU9A or Debbie Burton N9DRU, 1153 Union St., Marseilles IL 61341-1710. Tel. (815) 795-2201.***

JUN 8

BOULDER, CO The Boulder VE Team will conduct VE Exams at St. Mary Magdalene Episcopal Church, Heatherwood Dr. and Cambridge St., starting at 7 PM. Contact ***Barbara McClune NØBWS, (303) 530-2903.*** Pre-registration preferred; walk-ins welcome. Please bring a picture ID and one other ID; check or money order for $5.40, payable to ***ARRL-VEC***; the original and one copy of your current license (if any); the originals of applicable Certificates of Successful Completion of an examination, if you claim credit for any test elements; a copy of the FCC 610 you submitted, if you claim credit for a Novice license not yet received; soft pencils and a calculator.

JUN 12

ELLENVILLE, NY The Chaverim 6th Int'l Convention, sponsored by an assn. of Jewish amateurs and their friends, will be held at the Fallsview Hotel. For details, contact ***Arnold L. Halpern W2GDS, 450 Brighton Ave., Long Branch NJ 07740. Tel. (908) 222-3009.***

JUN 13

WINSTON-SALEM, NC The Forsyth ARC will sponsor the Winston-Salem Hamfest/Computer Fair from 9 AM-5 PM at the Benton Convention Center, downtown. Flea Market. VE Exams (pre-register). Admission $5 in advance, $6 at the door. SASE to ***Henry Heidtmann, Winston-Salem Hamfest, PO Box 11361, Winston-Salem, NC 27116. Tel. (919) 785-3900 (9 AM-10PM).***

MARMORA, ONT., CANADA The Eastern Ontario Hamfest, sponsored by the Marmora ARC, will be held at Marmora Area Curling Club starting at 9 AM. Admission $3. Tables $5. Tailgate $2. Talk-in on VE3TZW 146.655/.055 rptr. Contact ***George Foster VE3NKJ, (613) 472-5948.***

LOVELAND, CO The Northern Colorado ARC will present Superfest IX at the Larimer County Fairgrounds, 700 S. Railroad, beginning at 8 AM. Set-up Fri. eve. Jun. 12, or at 6 AM Sat. Free parking. ARRL VEC Exams. Camper hookups. Admission $3. Tables $7 ea. (for reservations contact ***Bill Morrison NØKMA, 1743 Eastwood Ct., Ft. Collins CO 80525. Tel. (303) 224-5305).*** For info, contact ***John Schmidt NKØR, 1001 King Dr., Loveland CO 80537. Tel. (303) 663-7581.***

BANGOR, ME The Pine State ARC will sponsor the Bangor Hamfest/Computerfest at the Hermon Elementary School. Take US #2 to Hermon Corner (at the monument) take the Billings Rd. for 2 miles to the school. Follow the signs. Free parking. Flea Market. VE Exams, all classes. CW contest. There are 3 campgrounds and many motels within 5 miles of the Hamfest. Contact ***Roger W. Dole KA1TKS, RR #2 Box 730, Bangor ME 04401. Tel. (207) 848-3846.***

HUNTINGTON, WV The Tri-State ARA, Inc., will offer VE Exams at Our Lady of Fatima church school classrooms, located at 545 Norway Ave., Huntington WV, at 10 AM. No pre-registration necessary. Arrange to arrive by 9:15 AM to register. Have ID and Form 610 checked prior to the exam. For more info, call ***Jim Baker K8KVX, (304) 736-6542.***

JUN 14

HUMBOLDT, TN The Humbolt ARC Hamfest will be held at the Humboldt High School Cafeteria, 2600 Viking Dr., from 8 AM-4 PM. Admission $5. Tables $5. Contact ***Ed Holmes W4IGW, 501 N. 18th Ave., Humboldt TN 38343. Tel. (901) 784-3490.***

STEVENS POINT, WI The Central Wisconsin Radio Amateurs, Ltd. (CWRA), will hold its 15th annual SWAPFEST at the University Center on the U. of Wisconsin-Stevens Point campus. Free parking. Wheelchair accessible. ARRL VE Exams. Tables and electrical power will be available for commercial vendors. For info and registration, contact ***Art Wysocki N9BCA, CWRA Swapfest Chairman, 3356 April Lane, Stevens Point WI 54481. Tel. (715) 344-2984.***

WINFIELD/CENTRAL, PA The SVARC and Milton ARC will co-sponsor a Hamfest at the Winfield Fireman's Grounds (60 miles North of Harrisburg, on US Route 15). VE Exams by pre-registration. Admission $4. Outside table/tail-gate space at $1/6'. Contact ***SVARC, Inc., Box 73, Hummels Wharf PA 17831. Tel. (717) 473-7050. Packet KD3KR @ NR3U.PA.***

LANCASTER, NY The Lancaster ARC will hold their Hamfest at the Elks Club Hall, Rt. 20-Broadway in downtown Lancaster, across from the post office. Large parking lot for outdoor Flea Market and general Hamfest parking. Admission $4 in advance till May 1, or $5 at the door (includes 8' outdoor flea market space). Vendors, contact ***Nick WA2CJJ, 5645 Genesse St., Lancaster NY 14086. Tel. (716) 681-6410; or George Ebert N2NOB, 1330 Bailey, Buffalo NY 14206. Tel. (716) 894-0343.*** Talk-in on 146.550 simplex or 224.640 rptr.

WILLOW SPRINGS, IL The 35th annual Hamfest, sponsored by the Six Meter Club of Chicago, Inc., will be held at Santa Fe Park, 91st St. & Wolf Rd., Willow Springs IL. Advance tickets $4, $5 at the gate. Large swapper's row. Free parking. Get advance tickets from ***Mike Corbett K9ENZ, 606 South Fenton Ave., Romeoville IL 60441,*** or any club member. No overnight camping. Gates open at 6 AM. Talk-in on 146.52 K9ONA/R 37-97.

COVINGTON, KY The Northern Kentucky ARC announces "HAM-O-RAMA 92"to be held at the Erlanger Kentucky Lions Park beginning at 8 AM. Set-up at 6 AM. Indoor exhibit area for major vendors. Outside Flea Market. Admission $5 ($4 in advance) with children under age 13 free. Flea market spaces are $2. Bring your own tables. Indoor vendor space $15 per table (provided). For info and registration, contact ***KC4FET c/o NKARC, PO Box 1062, Covington KY 41012. Tel. (606) 341-1213.*** Talk-in on 147.855+ or 147.375+ rptrs.

GRANITE CITY, IL The Egyptian RC will conduct its annual EGYPTIAN-FEST at the club grounds on Chouteau Place Rd., Granite City IL., from 6 AM-2 PM. Overnight camping Sat. VE Exams will be conducted at the Sanford Brown Business College, 3237 W. Chain of Rocks Rd. Pre-registration is requested, but not required. The class is limited to 60. Contact ***Eric Koch NFØQ, (314) 946-0948*** to pre-register. Advance tickets $1 or 6/$5; $2 or 3/$5 at the fest. Contact ***Jim Cleland K9RKU, PO Box 562, Granite City IL 62040,*** or call ***(618) 344-2401*** for info or tickets.

AKRON, OH The Goodyear ARC's 25th annual Hamfest/Family Picnic will be held at Wingfoot Lake Park near Akron OH, from 8 AM-4 PM. Family admission is $4 in advance, $5 at the gate. The outside Flea Market will be $3 per space. Inside dealer area $6 per table (advance reservations suggested). No overnight parking. No pets, no swimming please. For advance tickets and info, contact ***William F. Dunn W8IFM, 4730 Nottingham Lane, Stow OH 44224. Tel. (216) 673-8502.***

JUN 19-21

BURBANK, ALBERTA, CANADA The Central Alberta Radio League will sponsor their 21st annual Picnic at the Burbank Campground, located at the confluence of the Blindman and Red Deer River valleys. Registration starts Fri. afternoon. $15 per family unit camping fee. $10 single unit camping fee. $10 weekend private stall. $5 Sat. evening barbecue and dance (at 1800 h). Children under 12, $3. $6 per weekend pass (no camping). Event Station call VE6UK, 147.150+ 0.600 MHz; simplex 146.520. For further info and Golf registration, telephone ***Pat Wight VE6ALD, 346-3013.***

JUN 20

CYPRESS, CA The Catalina Amateur Repeater Assn. will hold its annual HAMFEST indoors at Cypress College, 9200 Valley View St., Cypress CA (just west of Knott's Berry Farm), from 9 AM-4 PM, in the Math/Science Bldg., near the lake. Admission $10, includes hamburger/chili luncheon. VE

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VE Exams. Vendors need to reserve space. Contact ***Jo Ann Taylor KC6NJG, (714) 777-1260, or FAX (714) 779-7761.***

MIDLAND, MI The 18th annual Hamfest, sponsored by the Central Michigan Amateur Rptr. Assn. (CMARA), will be held at the Community Center in Midland MI from 8 AM-1 PM. Admission $3. Tables $9 each. Talk-in on the Midland 147.60/.00 rptr. VE Exams, walk-ins welcome. Contact ***CMARA Hamfest, PO Box 67, Midland MI 48640.*** Please SASE. Or call ***Joe WD9GUF at (517) 631-8818,*** eves. and weekends.

JUN 20-21

WOLF POINT, MT Prairie Radio Club will host the annual Northeast Montana Hamfest Picnic at Wolf Point MT. Contact ***Jack Greenwood WB7QDN*** for info.

JUN 21

CROWN POINT, IN The Lake County ARC will host their 20th annual Dads' Day Hamfest at the Lake County Fairgrounds, beginning at 8 AM. Indoor spaces. Set-up at 6 AM. Admission $4. Tables $6. VE exams. Talk-in on 146.52 simplex and 147.00/.60 rptr. Contact ***Mike Warot KA9DGX, 7751 Chestnut Ave., Hammond IN 46324. Tel. (219) 845-7970.***

MONROE, MI The Monroe County Radio Communications Assn. will sponsor a Hamfest at Monroe County Fairgrounds, M-50 at Raisinville Rd., Monroe MI. Handicap parking. VE Exams. Advance tickets $3, $4 at the gate. Indoor tables $10 per 8' table. Trunk sales $3 per 8' space. Contact ***Fred Lux WD8ITZ, PO Box 982, Monroe MI 48161. Tel. (313) 243-1053 eves.***

CAMBRIDGE, MA The MIT Radio Society and the Harvard Wireless Club will co-host a TAILGATE electronics, computer and amateur radio FLEA MARKET, rain or shine, at Albany & Main St., Cambridge MA from 9 AM-2 PM. Free off-street parking. Admission $2. Sellers $8 per space at the gate, $5 in advance (includes 1 admission). Set-up at 7 AM. For info or reservations, call ***(617) 253-3776.*** Mail reservations before June 5th to ***W1GSL, PO Box 82 MIT BR., Cambridge MA 02139.*** Talk-in 146.52 and 449.725/444.725 pl 2A W1XM rptr.

FREDERICK, MD The Frederick ARC will hold its annual Hamfest on Father's Day at the Frederick County Fairgrounds from 8 AM-4 PM. Admission $4. Tailgaters $5 for each 10' space. Wives and children free with one paid admission. Indoor tables $10. For info, write to ***Frederick Hamfest, PO Box 1260, Frederick MD 21701.***

JUN 28

SOUTH BEND, IN A Hamfest Swap & Shop will be held in PARKING GARAGE Downtown on U.S. 33 ONEWAY North by the Society Bank Bldg. and Century Center, across the street from Winter Hamfest. Free parking nearby. Admission $3. Drive-in selling spaces $5 ea. Talk-in on 52-52, 99-39, 69-09, 34-94, 145.29. Contact ***Wayne Werts K9IXU, 1889 Riverside Dr., South Bend IN 46616,*** or phone ***(219) 233-5307.***

MILFORD, CT At 12 noon, the Coastline ARA will hold VE Exams for all classes at the Fowler Bldg., 145 Bridgeport Ave., Milford CT. Walk-ins welcome. Contact ***Gary NB1M, (203) 933-5125, or Dick WA1YQE, (203) 874-1014.***

JUL 4

HARRISBURG, PA The Harrisburg RAC will hold a Hamfest at the Bressler Picnic Grounds from 8 AM-2 PM. Set-up at 6 AM. Take Exit #1 if I-283, PA #441 North. Follow signs. Admission $4. Tailgating $6 per space. Tables $10 in advance, $15 at the Hamfest. Call ***Steve Gobat KA3PDQ, (717) 938-6943*** for table reservations.

JUL 11

SUMMERVILLE, SC The Trident ARC will sponsor CHARLESTON II Summer HAMFEST/COMPUTER Expo at the Charleston Southern U. Fieldhouse, I-26 (Exit 205) and US-78 East, from 0800Z-1500Z. Set-up at 0600Z. Wheelchair accessible. Free parking. There will be a True-Auction at 1400 hrs. Advance tickets $6 per family; $5 each at the gate. Tailgate $3. Pre-registered tables $10. Talk-in on 147.27+, 224.64- or 443.80+ Contact ***Chairman, Bubba Johnson N4CII, 5 Shoo Fly Cir., Givhans SC 29472; (803) 821-8100*** recorder, or ***(803) 871-7741.***

SPECIAL EVENT STATIONS

JUN 6-7

KEENE, NH Station KD1GJ will operate at the Monadnock Region Hot Air Balloon Festival, from 1400Z-2300Z each day. Frequencies: Lower portion of General phone bands on 80, 40 and 20 meters; Novice subband on 10 meters. For QSL, send QSL with SASE to ***KD1GJ, 52 Manchester St., Keene NH 03431.***

PHILADELPHIA, PA The USS Olympia RAC will sponsor Station WA3BAT aboard the USS Olympia, in conjunction with the US Naval Academy (W3ADO, USS Yorktown (W4USN), USS Little Rock (W2PE), USS Pompanito (WA6BXV), and the USS Drum/Alabama (K4RQQ), from 1400-2300 UTC, to commemorate the birthday of John Paul Jones, father of the American Navy. Frequencies: Phone-3.895, 7.245, 14.245, 21.365, 28.365 (all +/- 5 kHz). For a certificate, send QSL and a 9 x 12 SASE to ***Olympia RAC, PO Box 928, Philadelphia PA 19105.***

JUN 13-14

WARRENTON, VA The Fauquier ARA will operate Station K4LLQ at the US Army Communications-Electronics Command, Vint Hill Farms Station, Warrenton VA, during the Golden Anniversary celebration of this historic citadel of electronic warfare. "The Farm" was originally created as "Monitoring Station No. 1" during WWII to intercept radio transmissions. K4LLQ will operate 1300Z-2200Z. Frequencies: SSB-7232, 14232, 21322, 28432 kHz. CW contacts on request. Frequencies may move, depending on band conditions. QSL, SASE, or multicolor certificate (9 x 12 SASE and $3) to ***Fauquier ARA, 500 Hunton St., Warrenton VA 22186.***

CLINTON, IA The Clinton ARC will operate WØCS to commemorate the 1st anniversary of Riverboat gambling out of the port of Clinton IA. The station will be aboard the Mississippi Belle II floating casino. Operation will be from 0900-2100 CDT both days, in the lower 50 kHz of the General phone sub bands; on 40, 20, and 15 in the Novice segment on 10 meters. Also, 144.210+/- phone for EN41/EN42. QSL with #10 SASE to ***Darryl Petersen KD0PY, 1344 400th Ave., Bryant IA 52727.***

JUN 14

FT HAMILTON-BROOKLYN, NY The Kings County Rptr. Assn. will operate Station WA2ZWP from 1200Z-2400Z, at the base of the Varrazano Bridge, to celebrate the 167th anniversary of Fort Hamilton Army Post. Operations will be in the General and Novice phone bands around 28.343, 21.343, 14.343, 7.243. For certificate, send QSL and SASE to ***Charles Quartana N2JZA, 2175 East 8th St., Brooklyn NY 11223.***

JUN 20-21

JUNCTION, TX Pat Rose W5OZI will sponsor 1992 SMIRK Party Contest #17, from 0000 UTC June 20-2400 UTC June 21. To obtain a copy of the official log sheet, send SASE to ***Pat Rose W5OZI, PO Box 393, Junction TX 76849 USA.*** Contest entries must be postmarked no later than 6 July 1992 and sent to the W5OZI address.

ALTOONA, PA The Horseshoe ARC will operate Station W3QZF from 1300Z June 20-2100Z June 21, to celebrate the 1992 US Cycling Federation Olympic Road Trials and Nat'l Championships that will be held in Altoona. Frequencies: Lower portion of the General phone privileges on the 40-15 meter bands; and the lower portion of the 10m Novice phone sub band. QSL with SASE to ***HARC, PO Box 225, Hollidaysburg PA 16648.***

JUN 27-28

NORFOLK, VA The Tidewater ARC will operate Station W4NV 1600Z June 27-1800Z June 28, to commemorate the establishment of the US Army's Fort Norfolk as an historic landmark. Operation will coincide with Field Day and will be in all bands 80-10 meters, CW and phone, plus AO-13. For QSL, send QSL and SASE to ***Tidewater ARC W4NV, 1234 Little Bay Ave., Norfolk VA 23503.***

JUN 29-JUL 12

NIAGARA-ON-THE-LAKE, ONT., CANADA The Niagara Peninsula ARC, Inc., will commemorate the Bicentennial of John Graves Simcoe, First Lieutenant Governor of Upper Canada, Niagara-on-the-Lake, by operating Station XJ3S on 80 thru 10 meters SSB, CW, and RTTY. For a special QSL card, send a QSL, SASE (USA funds and postage OK) to ***VE3VM, Niagara Peninsula ARC, PO Box 692, St. Catharines, Ont., L2R 6Y3, Canada.***

Number 15 on your Feedback card

UPDATES

Crystal Matching and Activity Tester

The May 1992 "Circuits" column (page 64) has an error in the schematic. The 560 ohm resistor connected at one end to pin 3 of the 7400 is shown connected to pin 1. This won't work! This register must be connected between pin 3 and pin 2 of the 7400.

Also, although not noted in this piece, both inputs of the two remaining gates should be connected to ground—the gates not used, in the remaining sections of the 7400. I should have mentioned this but I guess I sort of assumed everyone would know one can't leave the gate inputs on unused gates hanging.

J. Frank Brumbaugh KB4ZGC
Bradenton FL

The SAM1 Transverter

There are changes to the information in the "VLF Information Sources" section of the article "SAM 1 Transverter" in the April 1992 issue (page 36). Since the first of the year (1992), both the *Northern Observer* and the *Western Update* have ceased publication. The information that would normally be included in these publications will now be included in the Longwave Club of America's monthly publication, the *LOWDOWN*. Their address is: The Longwave Club of America, 45 Wildflower Rd., Levittown PA 19057.

Due to the enlarged issues of the *LOWDOWN*, dues for the LWCA have increased to $18/year USA, $19 Canada (1st class), and $26 US funds airmail for overseas.

I hope the above information will be of interest to your readers.

Ken Cornell (ARS W2IMB)
Point Pleasant Beach NJ

The Rock Bender QRP Transmitter

The caption for Figure 5 in the above article in the April 1992 issue (page 22) contained an incorrect equation. If R is the local resistance and E is the voltage indicated by the DC voltmeter, then power = $(0.707E)^2/R$, **NOT** $(0.707E^2)/R$.

DXpedition Lessons from Peter I and Bouvet Islands

The callsign of Roald Steen, the author of the above article in the May 1992 issue (page 46), is AJ0N/LA8US, **NOT** AJØN/LA6US.

HEIGHTS TOWER SYSTEMS

Continued from page 44

entertainment value the project will provide for your neighbors as they watch your antics on the tower.

I found that the sections would go together easier if I used a tapered line-up pin, available from Rohn at big bucks or local hardware stores for much less. Oddly enough, I was told by ham tower dealers that they either did not know what this tapered pin was, or if they did know what it was they did not sell it and instead suggested the local hardware store. Why the big deal about this tool? It is one of Mr. Murphy's Laws that all six holes on a tubular tower's legs will never line up without divine intervention. No reflection on Heights here; this happens with them all.

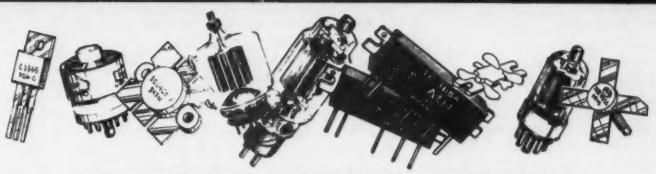
There are too many things that have to line up perfectly on top of a tower for it to work easily with a slightly canted tower under assembly. We really appreciated Heights' use of captive nuts instead of nuts with separate lock washers. One less piece of hardware to drop, right? I did quickly learn that before putting a captive nut on a bolt, the bolt must be clean. Any dirt on the bolt threads tends to seize the nut so it cannot be further tightened or removed. Now would be a good time to advise that you preacquire several spare bolts and nuts when starting the construction. Actually, I caused part of my own problem at first, since the first dirty bolt I encountered was fouled with the joint compound I was using. I used an aluminum-to-aluminum joint "grease" between section legs to prevent corrosion, improve conductivity, and facilitate future disassembly. These compounds contain finely ground aluminum powder in a lubricating base, and work fine until you get the compound between a bolt threads and a captive nut.

By now your new gleaming tower is up and ready for antennas. I'll leave that to other articles. Just one last piece of information you now need to stay sane: All self-supporting towers, and especially long tall ones, will "wiggle." If you get bothered by waves when on a boat, you may notice this effect more than others. The motion of the tower at the top is actually very slight, but will be definitely noticeable when you are up there. The tower is much stronger when it can wiggle with the wind a little instead of trying to stay rigid. It's funny; the tower looks shorter from the ground up than when you are on top looking down. Maybe this is a result of the tapered design?

If you've done it right so far, you now have a marvelous tower to support your DX dreams, and which will make a great, neighbor-pleasing Christmas light display support. I've put up a lot of different towers over the years, and I am quite favorably impressed with the Heights product. Youcan't go wrong with this company's customer relations—I've never seen anyone friendlier or more cooperative than Drake Dimitry at Heights.

Contact Mike Baker W8CM at 306 Woodberry Lane, Lynchburg VA 24502.

RF POWER TRANSISTORS AND TUBES



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QRP

Low Power Operation

Michael Bryce
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VXO Operation for the Ryan Exciter

Small crystal controller transmitters like the Ryan Communications exciter I described in the April issue are great fun. Crystal control does have one drawback: You're stuck on one frequency.

At first I was working on a simple VFO for the Ryan exciter. After a few days on the bench, my simple VFO became rather complex. My Ryan exciter is on 30 meters, so the need to have a large amount of frequency swing seemed like overkill. A better, and perhaps even simpler, way to move around the 30 meter band was to swing the crystal's frequency: a VXO.

The Ryan exciter's oscillator will not allow VXO operation as is. I tried several different variable capacitors in series with the crystal and got lackluster results. So, I built a completely new and different oscillator on a small piece of perfboard. I really did not want to make major changes to the Ryan exciter so I built a second board to contain the VXO.

A VXO Oscillator

The oscillator is broadbanded, thanks to T1. A 2N5179 will develop more than enough umph to drive the Ryan exciter. If you don't have a 2N5179, a metal case 2N2222A will work fine, too. The output of Q1 goes to the broadbanded transformer T1. The primary of T1 consists of 20 turns of #26 enamel wire on an FT-37-43 core. The center tap is at 13 turns from the collector end of T1. The secondary has four turns of #26 wound over the entire core. Don't bunch this secondary winding up on one end of the core; instead, spread the turns over the entire core.

The resistors on the output of T1 place a slight load on the oscillator. A 0.01 µF capacitor couples the output from the oscillator into the Ryan exciter.

You can use any variable capacitor for C1 as long as you don't go over 50 pF.

Use a good quality capacitor for C1 as you'll be running it back and forth through its range a great deal. A double bearing capacitor would be grand, but they are kind of hard to find. Check with KA7QJY Components (P.O. Box 7970, Jackson WY 83001) for his list of variable capacitors.

The crystal used for the VXO should be a fundamental crystal in an HC-25/U holder with a parallel resonance of 20 or 30 pF. Don't get high tolerance crystals, either. A tolerance of 0.01% is fine for the VXO. Crystals mounted in the FT-43 holders don't work well with VXO circuits.

Making it Work

There are two methods of getting the oscillator to talk to the Ryan exciter. Either one will work, and both require some changes or additional circuitry to accomplish.

The best method is to rework the crystal oscillator of the Ryan exciter to work with the new oscillator. I tried to couple the new oscillator into the base of the Ryan oscillator. This will work if you're really into milliwatting—I was only able to get about 300 milliwatts from the exciter.

To get full exciter output, you'll need to change some components in the Ryan oscillator. The first step is to change the 820k resistor on the base of the oscillator transistor, 2N4124, to 10k. Remove the 270 pF capacitor from the base of this transistor, too. These two changes make the oscillator on the Ryan exciter into a buffer/amplifier. You can still key the exciter as usual by grounding the emitter of the 2N4124. Connected this way, the output of our VXO, coupled to the base of the 2N4124 on the Ryan exciter, will provide operation exactly like a crystal-controlled exciter.

There is one catch to running the VXO and Ryan exciter this way. You have to keep the external VXO running all the time. You key the Ryan exciter by grounding the emitter lead of the 2N4124. This normally keys the crystal oscillator. Since we've changed the oscillator into an amplifier, the external VXO must run continuously. There are two fixes to this problem. First, just key the Ryan as usual, leave the VXO oscillator running all the time and remove power to it during receive. Or, you can short the key line on the Ryan exciter and key the VXO. To key the VXO, you'll need to add a keying transistor in series with the Vcc line. A simple 2N3905 will fit the bill here. I went a bit overboard and used a 2N4037 to key the VXO.

Since you may have to add the keying transistor to the VXO oscillator, you can then use a second method of coupling the output of the VXO into the Ryan exciter without swapping out parts. Simply couple the output of our VXO oscillator into the Ryan exciter, directly to the driver transistor. Add the VXO drive directly to the base of the 2N5089 driver on the Ryan exciter. When you do this, you must key the VXO as the driver will amplify whatever it sees and pass it to the final. You can key the VXO oscillator and not have to mess with the Ryan exciter, except for one shielded cable from the VXO.

Add a Buffer Amplifier

Because you'll not only have the benefit of the extra stage of buffering between the VXO oscillator and the driver stage, you may want to add a small buffer amplifier. I have not tried this but it would not be a bad idea. The schematic shows such a circuit taken directly from the *QRP Handbook* published by the ARRL.

This is an easy project to build on perfboard. I didn't make a PC board for it. Just keep the lead length short and direct. Test each circuit before you start on the second one. Be sure you have the Ryan exciter running on a crystal before you start removing parts from its circuit board. Remember, when your soldering iron hits the PC board of the Ryan exciter, the warranty goes up in smoke.

There you have it: VXO operation for the Ryan exciter. This will really bring out the QRP bug now that you are no longer rock-bound.

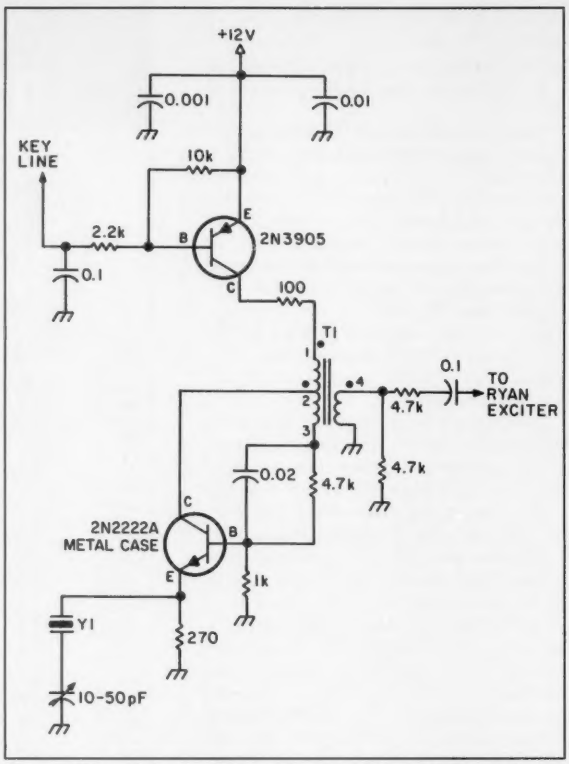

Figure 1. Schematic to allow VXO operation. T1: 20 turns of #26 enamel wire on FT-37-43. Tap 13 turns from the collector end; secondary 4 turns over primary. Y1: Fundamental HC-25/U; parallel resonance; 20-32 pF load capacitance.

Number 17 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2"x 11") sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. You may also upload a listing as E-mail to Sysop to the 73 BBS, (603) 924-9343 data bits, no parity, 1 stop bit. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Wanted: Manual for a Kintel 321 Volt Calibrator that I can buy or copy. *Erv Sly W6TKJ, 1053 Camino Caballo, Nipomo CA 93444.*

CLOSED CAPTION CHALLENGE. Wanted: Instructions on how to turn off the Closed-Caption Feature on a ZENITH SENTRY-2 Color Monitor, Model: J1324W, S/N: 121-23471074. This model wasn't supposed to have the Closed Caption, but it was hidden away on an all-purpose Integrated-Circuit Chip and got turned on by mistake. ZENITH won't tell me how to turn it off. Help! *Pat W. Kearney, 740 Belinda Ave., Barstow CA 92311.*

Wanted: Schematics or Instruction Manuals for: Model B24 Mini Products Beam Antenna. Model RK3 Mini Products Kit for B24. Will pay for reasonable copying and shipping costs. *Elmer Roth N0BUC, 118 Elizabeth Drive, Aberdeen SD 57401.*

We recently started a new fun project—a photo album of "Radio Cats." We are asking Hams/SWLS all over the world to send us picture(s) of their cat(s) along with name(s) and a short bio for each cat. Names and calls of all family members should be included. *Janis Cameron VE7AAP and Garry Cameron VE7ACM, 3528 11th Ave., Port Alberni BC V9Y 4Y7.*

SOS from Russia. We are the members of children's radioclub "Signal", founded in 1981 in Naberezhyne Chelny. We had a one valve transceiver UW3DI.

Now in Perestroyka's time, the State has abandoned us. Our old transceiver is broken. If the club won't work, they will take away our premise. Transceivers PA, ANT, and other equipment are not produced in the USSR. We are in need of transceiver PA and ANT. We can't make a transceiver because we don't have radio components or the experience. The transceiver can be old but reliable. We can't pay for the transceiver but will make you an honorary sponsor of our club. *UZ4PZC.*

Wanted: Schematic, op. manual, instruction manual for a Heathkit CW transceiver model HW-16, also anything on the VFO for the same rig. I will gladly pay any copy cost and postage. *Lyle Goheen N7VUE, 4316 N. 34th Drive, Phoenix AZ 85017. (602) 242-9490.*

Wanted: Information to repair a Wilson WE-800 2m FM transceiver. If you have a Schematic or manual for the WE-800, I would like to hear from you. *Jeff Harvey VE1BLL, 7 Birchdale Av., Dartmouth, NS CANADA B2X 1E6.*

Wanted: Schematic and/or manual for B & K model 1470 Precision Oscilloscope. I can copy and return same or will pay all costs. *Paul C. Bernhardt WD4EBA, 5553 Jamaica Rd. Coco FL 32927.*

Wanted: Schematic and/or manual for Regency model XL2000 VHF FM Transceiver. I can copy and return same or will pay all costs. *Paul C. Bernhardt WD4EBA, 5553 Jamaica Rd., Cocoa FL 32927.*

Wanted: Donation Contributions of amateur radio equipment from associated radio sale, Yaesu USA Cerritos, CA radio sale any kind of HF, UHF, or VHF radio equipment that can be used to homebrew 15 meter band. Phone or CW Rec this reference to KA1WWC, WOM W6ASI, PA4, KKN3Q, N4PGJ amateur radio nets TNX FB, W2NSD/1. *MacArthur Herman Moore KA3LLY, 5230 Heston St., Philadelphia PA 19131.*

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CT-90	10 Hz–600 MHz	< 10 mV to 150 MHz < 150 mV to 600 MHz	9	0.1 Hz, 10 Hz, 100 Hz	$169.95
CT-125	10 Hz–1.25 GHz	< 25mV to 50 MHz < 15 mV to 500 MHz < 100 mV to 1 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$189.95
CT-250	10 Hz–2.5 GHz typically 3.0 GHz	< 25 mV to 50 MHz < 10 mV to 1 GHz < 50 mV to 2.5 GHz	9	0.1 Hz, 1 Hz, 10 Hz	$249.95
PS10B Prescaler	10 MHz–1.5 GHz, divide by 1000	< 50 mV	Convert your existing counter to 1.5 GHz		$89.95

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SP-1 ..... $29.95 Case-CSP $12.95

TICKLE STIK

A shocking kit! Blinking LED attracts victims to pick up innocent-looking can—you watch the fun! Ideal for office desks, parties, nosey know-it-alls!
TS-4 kit $9.95

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Transmits audio over infrared beam up to 30'—use simple lenses to go up to ¼ mile! Hum free, uses 30 kHz carrier. Great for wireless earphones or undetectable "bug." Transmitter + receiver set, LB56 .. $19.95

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Full-fledged superhet, microvolt sensitivity, IC detector and 10.7 MHz IF. Tunes Std. FM broadcast band as well as large portions on each end. Ideal for "bug" receiver, hobby experiments or even as FM radio!
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A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2W rms output. Runs on 6 to 15 volts, uses 8–45 ohm speaker.
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Very popular sensitive all-purpose preamp, ideal for scanner, TVs, VHF/UHF rigs, counters. Lo noise, 20 dB gain, 100 kHz–1 GHz, 9V–12 VDC operation.
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$149.95

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CFX matching case set ..... $ 24.95

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Matching case & knob set, CQRP $12.95

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Build your own mini ham station. Sensitive all-mode AM, CW, SSB receivers use direct conversion design with NE602 IC as featured in *QST* and ARRL handbooks. Very sensitive varactor tuned over entire band. Plenty of speaker volume. Runs on 9V battery. Very EASY to build, lots of fun and educational—ideal for beginner or old pro. New 30-page manual. Add the case set for well-fitted professional look.
Your choice of bands $29.95
(Specify band: HR-20, HR-30, HR-40, HR-80)
Matching case & knob set, CHR $12.95

E-Z KEY CMOS KEYER

Send perfect CW within an hour of receiving this kit! Easy-to-build kit has sidetone oscillator, speed control and keys most any transmitter. Runs for months on a 9V battery. 28-page manual gives ideas on making your own key for extra savings. Add our matching case set for complete station look.
CW-7 kit $24.95
Matching case knob set, CCW $12.95

2, 6, 10 MTR, 220 FM RECEIVERS

Keep an ear on the local repeater gang, monitor the cops, check out the weather or just plain listen around. These sensitive superhet receivers are just the ticket. They tune any 5 MHz portion of the band and have smooth varactor tuning, dual conversion with ceramic IF filters, AFC, adjustable squelch and plenty of speaker volume. Runs on 9V battery and performance that rivals the big rigs! For a complete finished pro look, add our matching case and knob set with screened graphics.
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Specify band: FR 146 (2m), FR6 (6m), FR10 (10m), FR-220 (220 MHz)
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Matching case & knob set, CSS $12.95

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Run your own stereo FM station! Transmit a stable signal in the standard FM broadcast band throughout the house, dorm or neighborhood. Connects easily to line outputs on CD player, tape decks, etc. Runs on 9V battery, has internal whip antenna and external antenna jack. Add our case set for a "station" look!
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Fantastic receiver that captures the world with just a 12" antenna! Can receive any 2 MHz portion from 4–11 MHz. True superhet has smooth varactor tuning, AGC, RF gain control, plenty of speaker volume and runs on a 9V battery. Fascinating Scout, school or club project provides hours of fun for even the most serious DXer. For the car, consider our shortwave converter. Two switchable bands (in 3–22 MHz range), each 1 MHz wide—tunable on your car radio dial. Add some interest to your drive home!
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Shortwave converter kit, SCI $27.95
Matching case set for SRI, CSR $12.95
Matching case set for SCI,CSC $12.95

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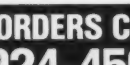

Hear exciting aircraft communications—pick up planes up to 100 miles away! Receives 110–136 MHz AM air band, smooth varactor tuning superhet with AGC, ceramic filter, adjustable squelch, excellent sensitivity and lots of speaker volume. Runs on 9V battery. Great for air shows or just hanging around the airport! New 30-page manual details pilot talk, too. Add case set for "pro" look.
AR-1 kit $24.95
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Microwave Circuits Designed From PUFF

Last month we went into the application programs necessary to set up PUFF and get it running. I wanted to establish an easy path to get PUFF up and running for the first time, compared to the start-up experiences both Kerry N6IZW and I encountered. After a little use this is all elementary, but in the beginning it can be a little defeating.

In addition to basic design, I want to cover the features needed to complete the amplifier circuitry. This includes the positioning of feed resistors, bypass capacitors and the actual location of the RFC feedlines to our stripline circuitry. The final product will cover the complete design for the device N6IZW and I picked to use, an NEC04583 GaAsFET. The design was for 10 GHz operation.

In the design as covered last month the striplines for both input and output networks were designed using the component sweep portion of PUFF. These parameters determine the exact dimensions for the striplines at the frequency specified. At this point, the circuit has matching stubs on both input and output striplines, as well as connections (in PUFF) to connector 1 and 2 as shown on PUFF's screen (F1). What is needed to make this a complete circuit is the DC feed RFCs' and bypass capacitors' connections, as well as the DC isolation capacitors on the input/output of the amplifier.

After all these items have been added, the final step is to add the ground foil covering most of the edge of the circuit board area. A note of caution: After the ground foil is added to the circuit artwork in (F1), do not run any plotting of parameters because that can cause the program to hang or lock up your computer. I guess what is happening is that there are so many unrelated items in the artwork PUFF gets confused. The program will not hang when plotting parameters with the RFC circuitry or bypass capacitors added to the circuit. This can be quite useful for seeing if your added components have any effect on the design. When you have completed your design, save the basic file before doing ground foil operations. Then save the final ground foil circuit in a different file name for artwork output. That way, if any errors are encountered you can go back and use the previous file.

Let's start with the RFC (RF choke) for the amplifier and cover how PUFF operates with RF chokes. We found a small error in the length of the RFC when specifying a 90 degree (quarter wavelength) long RFC. The program gave you a 90 degree RFC but its final length was not 90 degrees but actually something shorter. (The irregularity we noticed was that PUFF calculated the 90 degree line OK but when we placed it on the PC board it was positioned from the center of the stripline to the center of the connecting pad for DC bias. This made the actual length of this RFC something less that 90 degrees in actual artwork generation.)

The remedy for this problem is to make the RFC longer by half the width in electrical degrees of both the stripline and the connecting pad width. This would be an actual length of about 120 electrical degrees, making the actual RFC length much closer to a quarter wavelength long and a better RFC. Both short and normal RFC functioned quite well in actual use, the longer (pure 90 degrees) acting slightly better.

A stripline 90 degrees long at our frequency of interest is the same as a quarter wavelength of transmission line and presents a high impedance to the RF frequency. We make the resistance of this line in PUFF 140 ohms and it functions well as an RFC.

A new part is added to the parts list which is a t-line of zero ohms impedance and 1mm wide. This gives a space in which to place the input and output coupling capacitors on the stripline. To put these in the circuit, go to the end of the circuit and erase the connection to the connector by doing a "shift #" (either a 1 or 2) for the input or output connection. Then place the break on the stripline ends for our capacitor and reconnect the other end to the I/O connectors.

Placing the RFC on the board can require a little juggling. If you want the RFC to be at the input or output of the stripline it's no problem, but usually we want them placed somewhere mid-position on the stripline. To do this we have to reassign a fractional value for our input or output stripline and construct it back together with the fractional components equal to the original single part. In this way we can now go to any of the transitions between parts and place an RFC at those junctions. This involves lots of juggling, but it's not bad at all compared to making artwork on a CAD system with all its complexities.

At the bottom of the RFC t-line we can again connect striplines left and right for the DC bias feeds and bypass capacitors to ground. Don't forget to use another zero ohm 1mm break in the DC capacitor coupling point, the same as in the input output circuitry description for the coupling capacitor.

When all this is done you can define another short section of transmission line to be used in making the ground perimeter and bypass capacitor grounding terminations. This part of the circuit should be done on a copy of your near final circuitry. As I stated earlier, if you attempt a plot your computer will hang up and that will be that. Save copies and use them and if you encounter problems as the design progresses; you can always retreat back to the previous saved copy, saving you from any error.

10 GHz Amplifier Applications

The first project use of the amplifiers constructed to test the performance of PUFF and actual operation compared quite well. Kerry N6IZW constructed and tested a unique antenna system to serve as a microwave repeater for both SSB and WBFM at 10 GHz. Preliminary tests show that this system worked quite well and proved the reliability of the amplifier design to be used in our 10 GHz repeater.

First, a little about the "repeater." This repeater is not standard in that it consists of only an amplifier and two antennas. The design for this system was the inspiration of Kerry N6IZW who has worked at this method by first demonstrating it on a spectrum analyzer on his workbench. Bench tests showed that about 60 to 80 dB of isolation could be obtained between two omni slot antennas for 10 GHz placed on opposite ends of an eight-foot section of standard waveguide. One antenna is pointing upwards and the other antenna is pointed downwards. At one antenna an amplifier with 50 to 60 dB of gain is inserted between the two slot antennas separated by the waveguide section. See Figure 1 for details.

The amplifier consists of four each of the amplifiers that we designed and built using the PUFF program. The devices we used were the same NEC-04583 GaAsFET devices as shown in the examples (10 dB per stage and about a 1-2 dB noise figure, hopefully—we haven't measured them yet). The amplifiers that we constructed worked well and reflect very well on the PUFF design program. Measured results compared quite closely to PUFF's prediction of 11 dB per stage. Kerry was able to obtain about 18 dB of gain per stage with custom adjustments with very small copper "snowflakes." These were attached to a toothpick and used to position the copper pieces (about 25 to 50 thousandths square) on the printed circuit board to tune the amplifier for maximum gain. At the 18 dB gain level the amplifier started to break into oscillations and was very unstable. Reducing the single stage gain to the 10—12 dB limits allowed the stable design needed to facilitate packaging it into a housing.

The amplifiers Kerry constructed were wrapped on the edges with 1/2-inch-wide, 0.025-inch-thick copper flashing to form the case sides, and very short grounding for the amplifier edge ground connections. Copper sheeting about 0.008 inch thick was used to form a case cover. The ground foil side of the amplifier formed the bottom of the amplifier. Both sides of the printed circuit board ground foil were soldered to the copper flashing and form a very solid case for the PC board, as well as for feed-through capacitors for power and the coaxial connectors.

Let's get back to the 10 GHz repeater concept. The amplifiers just described were connected in tandem—that's four amplifiers in series providing about 40 dB of gain. The final, fifth amplifier, a broadband commercial unit capable of another 10 to 15 dB of gain with a maximum of +20 dB output, was used to drive the output omni-directional antenna. The total stack of amplifiers provided gain slightly better than 65 dB.

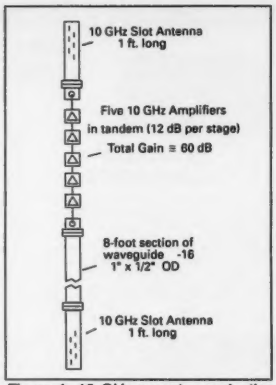

Figure 1. 10 GHz repeater evaluation system for a NEC-04583 GaAsFET amplifier.

The System Test

Testing the system proved quite interesting and was planned for our annual Christmas party and white elephant gift giving session. The test: I held aloft the antenna structure which was mounted on a 10-foot section of 2 x 4. Don WD6FWE operated the 12-volt battery feeding the amplifier repeater. Kerry set up a low power transceiver operating at 10.368 GHz, using a 10 dB horn antenna pointing out of his garage. Ed W6OYJ operated portable and moved a couple of houses away and pointed his small horn in the 90 degree path offset from Kerry's transmitter beam.

They communicated with just barely marginal signals received on both ends of this short low power test path, about S-1 to S-2 signals. Then the battery power was turned on to the 10 GHz amplifier repeater for a test. Both Kerry's and Ed's rigs were in direct sight of the repeater antenna and out of sight of each other. With the power on the repeater, Kerry reported an improvement in Ed W6OYJ's signal. As a matter of fact, the improvement was four S-units on Kerry's HT. Ed reported about the same improvement on Kerry's transmission. The repeater worked quite well on its maiden flight.

Power to the amplifier repeater was interrupted several times to confirm operation through the amplifier (not attributed to other sources). Each time power was interrupted signals

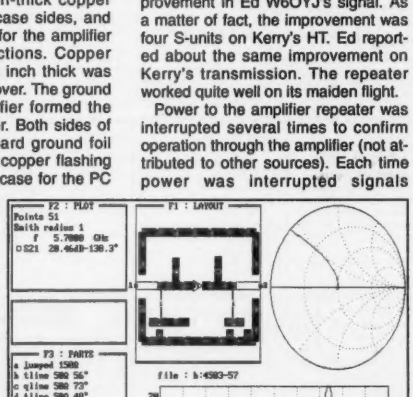

Figure 2. 5760 MHz amplifier design.

dropped to their previous levels of just perceptible and low readings on the S-meter.

Some of you may wonder why we started such a project instead of using a crossband type repeater similar to many of the satellite systems (translators) used before. Well, if this method proves out with further testing and much greater distances involved, we will lift the veil of 10 GHz communications obstacles such as small hilltops and such. A further benefit is that both wideband FM and SSB will both work on this type of amplifier repeater as it is dealing with bulk frequency input output and not mode of transmission. Frequency will be limited to amateur band transmission of course by the addition of suitable filters to remove the possibility of repeating out-of-band transmitters. I will keep you informed on the progress of this system. This is just a method of experimentation that is hopefully going to continue to perk interest in our 10 GHz microwave bands.

What this project has provided is a test of the amplifiers that were constructed under the PUFF design constraints. In the above test it was shown that the amplifiers were very stable and could be operated in concert with each other in the tandem approach needed for the direct-feed antenna that Kerry N6IZW constructed and tested. Some of the early amplifiers were coupled with directional couplers to help stabilize the amplifier string. It remains to be seen if this repeater concept proves to be of greater benefit. The repeater functioned, but better yet it proved the individual amplifiers constructed with the PUFF program. I can't rave on enough about this program—the more I use it the more it delivers high quality performance.

I will provide artwork for the test amplifiers we constructed for the 5.6 GHz and the 10.368 GHz bands for your consideration. These are tried and tested amplifiers, and are shown in Figures 2 and 3 respectively. Please be aware that there might be some aberrations to the artwork due to photograph reproduction and printing irregularities making the final dimensions shown off scale by a small percent.

Mail Box

I received a letter from Ken Stoval K2MPD on adjusting a Frequency West brick oscillator to the amateur portion of the band. Well, that's no problem and I can do it for you as long as the adjusting filter screws are not stuck or suffering from some other problem. Please include the IF frequency you intend to use so it can be set up properly. In Ken's case, he wanted 10 GHz operation on 10368 GHz SSB with a 144 MHz transceiver. The crystal frequency he selected was 94.666666 MHz to operate the brick oscillator on the 108th harmonic, or 10224 MHz. That's 10368 MHz minus 144 MHz (IF) = 10224. This will work just fine, but with the IF system operating on 144 MHz I suspect that there is no room for error on other stations frequently used for 10368 MHz. This system is capable of upwards frequency swing but not downwards. If errors are detected on communications, the stations in question will have to move up in frequency to accommodate operation.

Ken states that the 144 MHz IF system is used by a group of about eight amateurs in the New Jersey area and that all of them have experienced some trouble with the local oscillator for their SSB systems. That's the reason he wants to use the Frequency West brick to overcome this problem. They lost access to a spectrum analyzer and this made adjusting the bricks filter a lot more difficult. With an analyzer most bricks can be adjusted in about an hour or less in most cases.

The 144 MHz IF will work well; I just wanted to point out a possible weak link in frequency shift. I use a local oscillator frequency of 10223 MHz, one MHz lower in frequency that the above example. This makes an IF frequency of 145 MHz, giving maximum frequency adjustment possible on the IF to correct for any error encountered. In this case the crystal frequency for a Frequency West brick was selected to be 100.2254902 MHz times a multiple of the 102nd harmonic to equal 10223 MHz. We find this system to work quite well at this multiple and IF frequency arrangement.

A further benefit is that crystals over long periods of time age downward in frequency. I have a crystal that is about three years old and will no longer oscillate in the Frequency West bricks circuitry at its stated frequency. I have to reset the crystal 2.5 kHz low in frequency to maintain activity. This means that at 10 GHz the frequency is now about 250 kHz low also. I corrected for this by raising my IF frequency accordingly to 145.250 kHz. If you know where your local oscillator frequency is, an IF correction will put you back on the proper RF frequency. This method will work well as long as you are not into high stability work. Our microwave group designed a stabilizer circuit to work with on frequency crystals at 100.2254902 MHz (10223 MHz LO output). For this application, the crystal must be on frequency and can't have accuracy problems. More on that in another column.

I will be glad to answer your questions regarding microwave or other related questions. For a prompt answer please include an SASE.

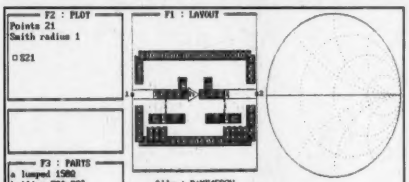

Figure 3. 10.368 GHz amplifier design.

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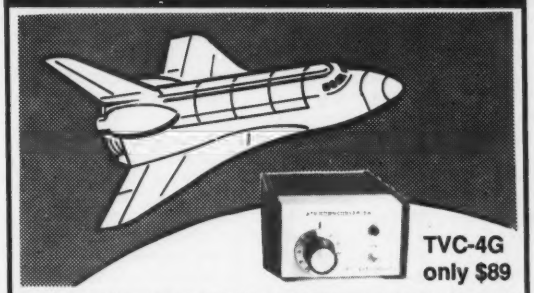

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Boy, is it great being in the Space Age! And just think, the amateurs of the world have a chance to make contact with amateurs in space on the Mir *orbiting platform, and also during the space shuttle flights of the U.S., both using the 2 meter downlink frequency of 145.550 MHz.*

The primary difference between the two operating procedures is that Mir *uses simplex on 145.55 for its voice and packet communications and the space shuttle will use duplex operation for voice communication, earth-bound users uplinking on either 144.91, 95, or 97, and receiving on 145.55.*

You might ask, why am I bringing up this subject in this column? One reason, and maybe the primary one, is that I was one of the ones lucky enough to have had voice contact with the space shuttle Atlantis *(STS-45) when it orbited the earth in March and April. The QSO was very short, if you could even call it a QSO, but I was able to listen in on a few of its scheduled contacts with schools and other organizations as it passed over the northeastern part of the United States.*

I have also made contact with Mir's *packet personal message system to leave a message for 73's fearless managing editor, Bill Brown WB8ELK, using only a handie-talkie for power feeding a quarter-wave ground plane made out of a coat hanger with hi-loss feedline. Not the most efficient way of making the contact, but it worked. Don't put down the power of a handie-talkie and home-brew antennas! I'm sorry that Bill did not get the message (room had to be made for newer messages) before he made contact himself. I have even heard of hams using* Mir *as a digipeater to make more distant contacts on packet. Of course it is only as good as both stations being able to* ***SEE*** Mir *at the same time, and that time is very limited, of course.*

Secondly, I bring the subject up to highlight how small our world really is. These orbiting platforms circle the earth every 90 minutes or so, depending on the orbit altitude, and every orbit covers a slightly different path over the surface. Everyone with a radio capable of receiving 145.55 MHz has a chance to at least hear these amateurs in space.

And lastly, to again highlight that the non-military space shuttle communications are rebroadcast on amateur radio frequencies. This service is provided by several organizations in the United States. I am most familiar with the WA3NAN rebroadcasts from the Goddard Space Flight Center in Greenbelt, Maryland, because I listen to them when I can. I am not attempting to slight any of the other rebroadcasters. I just hope that ALL people have a chance to hear just how much scientific data is being gathered on these missions and that even though these missions are very expensive, you and I may have a chance to benefit from this knowledge in the future.

—Arnie N1BAC

Roundup

Japan From the JARL News: JARL's General Assembly is scheduled for May 24th at Ise City in Mie Prefecture (JA2 area). This will be one of the JARL's most important annual meetings inasmuch as it is the time when the budget will be discussed and decided upon by members gathered throughout Japan. Additionally, various programs and activities for the year will likewise be outlined and scheduled.

The event will be a first for Ise City, famed for its historic Ise Shrine and Toba, reputed for cultured pearls. Hence it is of no surprise to learn that the Assembly has come to be known as the "Pearl Assembly" and the design of the symbol mark depicts none other than a young lady pearl diver.

Following are some of the events scheduled: operation of a special station with a commemorative callsign "JA2RL" will go on the air to make known the existence of the meeting; a display of the newest amateur radio equipment by the Japan Amateur Radio Industries Association (JAIA); junk market and a number of other attractions that are in the planning stages.

Ham Fair '92

This year's Ham Fair '92 has all the earmarks of being a G-R-E-A-T Fair! We urge you therefore to mark the dates August 21 to 23 on your calendar. It will, as in previous years, be held in the New Hall of the Tokyo International Trade Center in Harumi, and it is reputed to be the largest show of this kind.

Last year the event attracted as many as 60,000 visitors, including visitors from no less than 17 foreign countries. We hope for many more this year. The catch phrase for this year is: "Land of Amateurs," with "Rediscover the Pleasures of Ham Radio" as the theme.

Secretary General of ARI Visits JARL

Mr. Mario Ambocci I2MQP, Secretary General of Italian Amateur Radio League (Associazione Radioamatori Italiani, ARI), who participated in the operation of ZA1A in Albania at the time of its opening last September, visited the JARL office in Sugamo, Tokyo, in the latter half of January 1992.

A special plaque symbolizing friendship between ARI and JARL was personally handed over to JARL's Secretary General, Mr. M. Kumagai JJ1WUC, who expressed appreciation at this thoughtful gesture. Later, under the guidance of Mr. Arisaka JA1HQG, Mr. Ambocci was shown around the exhibition room and the JAS-1b (FO-20) control room. Mr. Ambocci operated AZ1A with Mr. Arisaka when they were both in Albania last year.

Photo A. Photo of UC2AAA and friends on Snake Island. 1st row (L-R): RB5FF, RB5ZM, RO4OE, RB5FT. 2nd row (L-R): UB4FA, UC2AAA, UB5FBV, RC2AR.

Scotland *From John "Paddy" McGill*: Continuing information from the Scottish Tourist Board (Radio Amateur) Expedition Group, June 20/21; GB8GC, Glamis Castle, Angus. A Royal Residence since 1372, family home of the Earls of Strathmore and Kinghorne. *[Check the May issue for frequencies and times. Otherwise, download the whole thing from the 73 BBS.—Arnie]*

Switzerland *From the International Telecommunication Union (ITU) Press Release*: The World Administrative Radio Conference (WARC 92), which was meeting for a little over four weeks at Torremolinos, Spain, closed with the signature of the Final Acts in the night of March 3, 1992. The Conference was attended by more that 1,400 delegates from 127 countries of the ITU's 166 Members and by observers from 31 international and regional organizations.

HF (Short-wave Broadcasting) Additional frequencies were allocated on a worldwide basis, subject to planning, reserved for single-sideband emissions and will become available for broadcasting on 1 April 2007 (shared usage). In respect of single-sideband techniques, a Recommendation on the introduction of SSB was agreed. The Recommendation invites the ITU Administrative Council to place on the agenda of the next WARC the request of WARC 92 to consider the possibility of advancing by as much as possible the date of 31 December 2015 for the general introduction of SSB and the cessation of double-sideband in all bands. The Recommendation recalls that some administrations have recommended advancing the date by up to 10 years. *[This only impacts HF Commercial Broadcasting interests, but would knock down the carriers of double-sideband on shared frequencies.—Arnie]*

Amateur Service Given the fact that no spectrum was freed by WARC 92 in the 7 MHz band, a further worldwide allocation to the amateur service in this band was not considered possible. A Recommendation (COM4/C) was therefore adopted inviting a future WARC to consider the possibility of

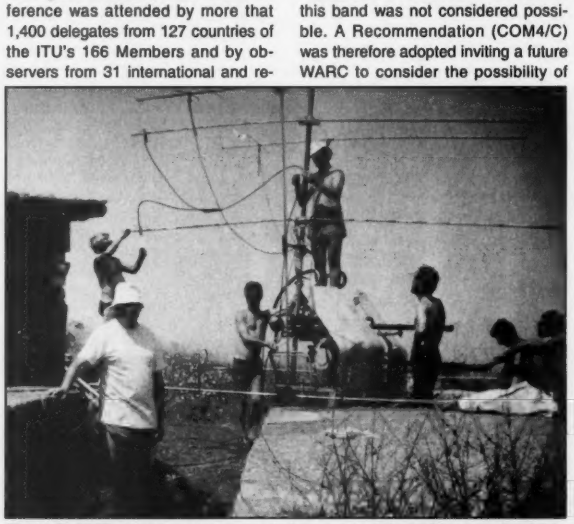

Photo B. VHF antennas were mounted on a coastal machine-gun turntable. UC2AAA at left.

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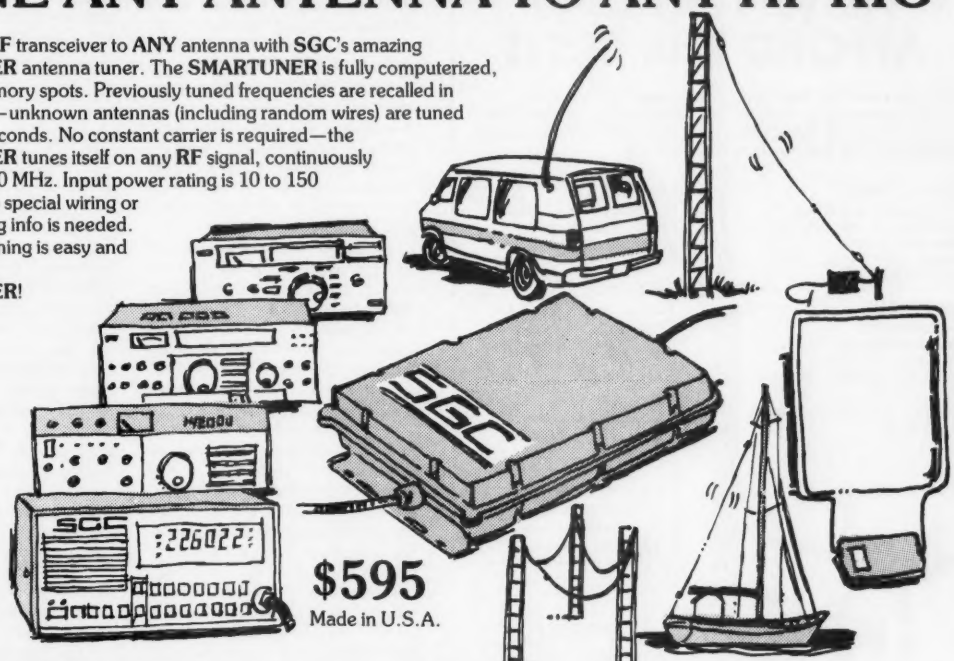

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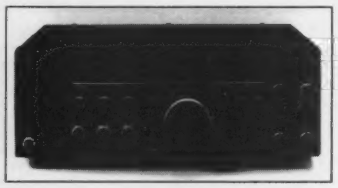

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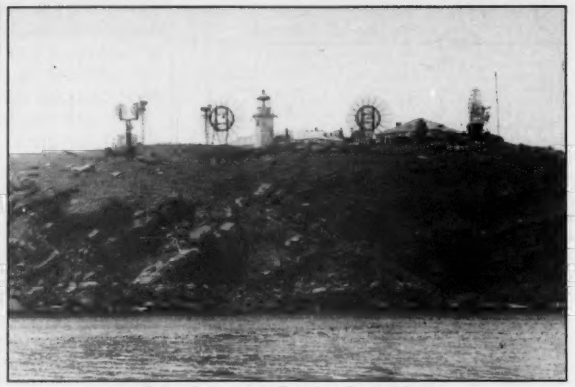

Photo C. "Antenna Farm" on Snake Island.

aligning the allocations to the amateur and broadcasting services around 7 MHz so as to provide a worldwide allocation. *[It looks like we live with the shared use of the 40 meter band for at least another **23 YEARS** (the next WARC is scheduled for 31 December 2015).—Arnie]*

Wind Profiler Radars Furthermore, a Recommendation (GT-PLEN/A) concerning the study, by the CCIR, of the characteristics and requirements of wind profiler radars was approved with a view to allocating appropriate frequency bands around 50, 400, 1,000 MHz. Wind profiler radars are used by meteorological services to measure wind direction and speed as a function of the altitude. The information is vital for the safety of air navigation, particularly at the time of landing; the absence of such information might have had an impact on several aircraft crashes in the past. The Recommendation also invites the ITU Administrative Council to include on the agenda of a future WARC the question of appropriate frequency allocations for the operational use of wind profiler radars. *[In the United States, even though the wind profiler system has been tested around 400 MHz, the FCC has already taken the "bull by the horns" and has decided to use 449.0 MHz +/- ? MHz or so, as the frequency spectrum to use, thus impacting our use of amateur repeaters in the same shared spectrum. At the moment it is only in certain areas, BUT, what will happen in the future? Are the U.S. hams losing more spectrum without replacement frequencies? Maybe so!—Arnie]*

Belarus *From a letter from Dr. Valery Pristavko UC2AAA:* "Buy A Piece Of The Rock?" was one of the topics related by "Larry" in his letter to Wayne. He enclosed a few photos taken by him on a visit to Snake Island in the Black Sea (N45-15.38, E30-12.3). One day while Larry was there the Commandante of the Island remarked, "I was told that you guys are willing to buy this isle. Do it, PLEASE!" *[In the pictures you can see that the island does have a very unique antenna farm!—Arnie]*

Larry asks that we mention an independent QSL Bureau for the ex-USSR with no charges for incoming mail. It is "QSL CHERNOBYL, Box 17, 220012 Minsk, BELARUS."

[A little sidelight from the letter: Larry remarks that his correspondence with Wayne many years ago was noted by the members of the KGB and he had a chance to know the KGB's opinion of Wayne. Larry was told, "He is a fine example of a young American Capitalist, willing to expand its empire." Does that sound like Wayne?—Arnie]

BULGARIA

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First, thanks for the replies from some of the *73* readers, which included KC1YR, KB8AOB, N5VGC, WA8FLF, and GØNEE. Based on the feedback of a questionnaire, I am providing some background on ham radio in Bulgaria for this issue and will provide some information on the digital modes in Bulgaria in the future.

Ham Radio in Bulgaria

To understand the ham radio activity from Bulgaria better, one has to bear in mind that the average salary for one month is about $50US. That is why most of the private stations here are running home-brew setups. According to the last LZ callbook, there are about 1,200 ham radio stations in Bulgaria, but I think about 400 of them may have working SSB/CW equipment. For example, here in Russe, the fourth largest LZ city with about 300,000 inhabitants, there are about 30 ham radio stations listed. But only seven or eight of them have working equipment and are active. Also, there are only two 2 meter FM setups. Therefore, the ham activity from here is concentrated in the LZ Radio Clubs.

You can recognize these clubs from their three-letter suffix calls starting with a "K" for club, e.g. LZ2KIM. Most of the clubs are so-called "city clubs" where all local hams are united. There are also ham radio clubs at some schools, universities, factories, etc., Depending on the main interest of the members, some of the clubs are contest, fox hunting, digital modes, etc.

oriented. Sponsored by factories, companies, universities and schools, during the last 10 years almost all clubs managed to obtain factory-built equipment. Most of the transceivers are Kenwood TS-830s and the computers are Apple II compatibles. So the main reason that ham radio activity is concentrated in the radio clubs is that almost all of them are well equipped compared to private stations. Another reason the ham radio activity is concentrated at the clubs is that they are manned by paid station managers.

Licenses

In Bulgaria, amateur radio activity is governed by the Ministry of Communications. There are three levels of amateur licenses, called respectively C, B, and A. The licenses for C level are issued by the local radio club. All C license holders can operate with up to 50 watts input on 80, 40, and 2 meters and above. The licenses for B and A level are issued by the Ministry of Communications. Holders of B licenses may operate all bands with up to 250 watts while all A licenses holders may do that running up to 1 kW input.

The examinations for all licenses cover four main areas: some LZ/ITU/IARU rules and regulations, radio theory, on-the-air operating skills and an optional Morse code test. The only restriction for the no-code license is that holders are not allowed to operate CW. After passing the exams and getting the license, one may apply for permission to install a private station and get a callsign. There are lots of hams who have passed the exams but are not able to build or buy equipment, so they are allowed to operate from any club station using the club callsign. All club stations have three-letter suffixes against the two-letter suffix of the private stations. All stations with odd numbers in the prefix are located in the southern part of Bulgaria and even numbers are in the northern part. The only exception are some contest callsigns with one letter in the suffix only.

One last item for this issue: The LZ DX Contest will be held on the first Sunday in September, from 0000 to 2400 UTC. It will be CW only on 3510-3560, 7000-7040, 14000-14060, 21000-21080, and 28000-28100 kHz. Logs should be sent to Central Radio Club, PO Box 830, Sofia 1000, Bulgaria. *[Further information may be obtained on the LZ DX Contest and other Awards on the 73 BBS.—Arnie]* 73 de Milen LZ2MP.

ISRAEL

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Code-Free Comes to Israel

The Israel Ministry of Communications has announced the inception of a new license category. Called the Technical Class, there is no Morse requirement.

An excerpt (freely translated here) from a memorandum circulated by the Ministry of Communications clearly explains why this new license class has been introduced: "In light of the fact that in the European countries and even in the United States a new license grade (Technical Class) has been implemented, in which there is no demand to be examined in Morse (transmitting and receiving), the representatives of the Israel Amateur Radio Club (IARC) requested the establishment of a similar license class in the State of Israel as well."

The technical examination is the same as the Grade "B" (General) test, plus additional questions dealing with new technologies. Thus, instead of Morse proficiency, the examinee will have to demonstrate some knowledge of digital communications, computer structure, operation and interfacing, satellite communications, and orbiting mechanics.

The Technical Class licensee will have the same privileges as the Grade "B" (General) holder on the frequencies above 30 MHz. The first examinations should be held in April 1992, and it still remains to be seen what new callsign prefix will be assigned to the "Techs."

As in other countries, a debate on the no-code has gone on both over the airwaves and on the pages of *HaGal*, the magazine of the IARC. Although some hams will continue to strongly express their opinions on the subject, the matter has been practically settled. But now those poor souls who claimed that Morse was an insurmountable barrier to their gaining a ham license have no further excuse!

Last time, I reported on the authorizations of autopatches for emergency use only for contacting police, firefighters, and ambulance services. Now, the Ministry has stated that it intends in the future to allow full autopatching, but for Grade "A" (Advanced-Extra) license holders alone. You may recall that only Grade "A"s are permitted to use phone patches in their stations.

In the same circular, the Ministry of Communications said that they have invited a representative of the IARC to participate in their deliberations to decide the Israeli position with regard to frequency allocations in the World Administrative Radio Conference (WARC 92) coming up this year. The Ministry representatives have stated in the past that the Israeli delegation to WARC 92 will act favourably to protect amateur radio interests.

There is talk of widening the amateur allocation on the 6 meter band, which is presently here a mere sliver from 50.100 to 50.150 MHz, and at present for the Grade "A"s alone. Policy on this matter will be set in deliberations with the IARC and the government agencies that are the primary users of this part of the spectrum. In the meantime, 6 meter DXers worldwide should keep an ear open for 4X1IF on the frequency noted previously. 73

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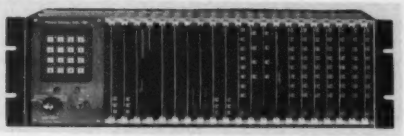

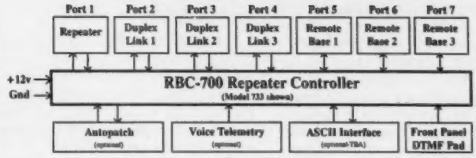

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Several models are available and are software configurable to support up to 3 Repeaters, 5 Duplexed Links, and 4 Remote Bases. A group or club can start with the basics and **expand** their controller anytime by simply adding boards and software. Free software upgrades for one year after delivery. Finally, a real controller for the Linked system operator !

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Playing the Numbers

It seems as if, every time you turn around, more and more devices are going digital. By now, we hams are very used to frequency synthesizers, memories and digital control of transceivers. But are our rigs truly "digital"?

Nope. Our radios are really not much different inside than tube rigs of 25 years ago! Oh sure, the frequency generation scheme is quite different, but the signal chain, from antenna to speaker, is much the same as it always was: a front end, mixer, IFs, detector and audio amp. So what's wrong with that?

Nothing, really. But certain very important receiver characteristics, such as selectivity, are limited by the basic nature of analog circuitry. There are better ways to receive signals, and they may be coming to a radio near you, though probably not very soon. For that matter, there are entirely different ways to encode voice information, and they may hold the key to far better audio quality and tremendously reduced QRM. The buzzword of the future is DIGITAL!

Thanks to the incredible compact disc, everybody knows that you can digitize audio, store it, send it, manipulate it and then reconstitute it back to its original analog form. The best part is that no quality need be lost during the journey. Let's take a look at the basics of digital technology. When we're done, we'll explore how it might affect ham radio in the years to come.

No Free Lunch

Analog audio consists of a continuous, changing voltage which follows the original sound pressure waves from whence it came. Any unintentional change to that wavering voltage constitutes distortion. Such change can result from noise, circuit imperfections, QRM, etc.

Digital data consists of sets of numbers represented by electrical "ons" and "offs." Having only two states, the data is easily recovered after passing through noisy, distorted channels. After all, the noise would have to be pretty bad before you might mistake an "on" for an "off"! The small distortions which would ruin an analog signal aren't even noticed with digital data.

Obviously, there's a price. Since, at any given moment, the signal can only describe two states, it holds less information than it would if it were analog. Thus, there are going to have to be lots and lots of numbers flying around if we are going to describe all those subtle changes in the original signal. The result is that digital signals take far more bandwidth than analog. There are ways to reduce the penalty, though, and we'll look at them a little bit later.

All Right, Break It Up

So how do you digitize an analog signal? It's really not that hard. You simply measure the voltage at discrete moments and turn those measurements into digital data. It's kind of like using a digital voltmeter real fast. The result is a series of "samples," each of which tells you what the analog signal's voltage was when you took the measurement. Ah, but what about changes which occur *between* measurements? That's not a trivial matter and is, in fact, central to the whole concept of sampling.

Ny Who?

There was a fellow named Nyquist, and his theory claimed that a signal could be fully described by taking only two measurements per cycle. Thus, in order to properly digitize a signal, the sampling frequency (how often the measurements are made) should be twice the maximum frequency present in the signal. But how can you describe an entire cycle in only two measurements?

Really, you can't. That is, unless the signal is a sine wave! Obviously, if you know the signal is, in fact, a sine wave, and your samples tell you the size and position of the two peaks, you can reconstruct the sine wave quite well. But audio isn't made up of sine waves, so what good is it?

Fourier's A Jolly Good Fellow

According to another fellow, named Fourier, *any* signal can be decomposed into a series of sine waves, with the slowest one being called the "fundamental" and the others being called "harmonics." When added together, point by point, those sine waves will reproduce the signal. No, we don't actually have to do such a thing in order to digitize a wave. The point is this: When a wave has no harmonics, it *must* be a sine wave! If it is any other shape, there will be harmonics. So, if we strip off the harmonics, we've got a sine wave. At or near the upper frequency limit of any system, all you can have are sine waves, because the harmonics are lost above the frequency limit. Thus, if we sample our signal at twice the maximum frequency of any harmonics in it, we can describe the highest harmonics with only two samples because *they must be sine waves anyway*. And if we've described it all the way up to its highest harmonics, we've captured the entire signal! By the way, that's why all those misinformed critics of CDs are wrong when they say that sampling causes you to miss some information in the original music signal. All sampling does is define a *maximum frequency response* for the signal chain. If you sample at 44 kHz, you can accurately describe any signal up to 22 kHz, with absolutely no loss of information. By the way, in a CD player, the filter which follows the signal's reconstruction to analog smoothes those upper-frequency samples back to sine waves for the same reason—it cuts off their harmonics!

Using Your Alias

If you input a frequency which is greater than half the sampling frequency, though, things get strange. Imagine some sine waves. Now imagine that you sample them only once per cycle. If you

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reconstruct those samples into voltages, you will see that the result is just a straight line! That doesn't describe the original signal at all, does it? If you sample at say, 1.5 times the signal frequency, it gets even weirder. Try it. Draw a bunch of sine waves and then, using a ruler, pick points on it every 1.5 cycles. Now, connect the dots. What have you got? Garbage! This is called "aliasing," and it sounds terrible. That's why CD players sample a little bit faster than twice the desired 20 kHz input bandwidth; the input and output filters don't have perfectly steep slopes, and keeping the music signals away from the *Nyquist Limit* helps eliminate aliasing.

That's Deep

So now you know what's involved in the "horizontal" aspect of sampling. In other words, how often you have to do it. But, there's a "vertical" aspect as well. The more bits (digital "ons" and "offs") you use in each sample, the more precisely you can describe each voltage measurement. If you only have two bits, you can only describe four possible voltages, because there are only four possible combinations of two bits. They are: 00, 01, 10 and 11. That's not much resolution! If you have 16 bits, though, you can break the measurement into 65,536 parts. (No, I'm not gonna list them all here!!) With that kind of precision, the inherent distortion is reduced to a very tiny fraction of a percent. Of course, that means you have to send lots more bits, so you need lots more bandwidth. A CD player reads about 2 megabits per second off the disc. Not all of that is music, though; some is for the time counter and some is for error correction. But 44.1 kHz times 16 bits times two channels equals over 1.4 megabits per second, so forget sending it over 20 meters, at least in real time!

What's the Point?

Of course, ham communications don't require CD quality. In order to digitize an HF-grade voice signal, we need to take about 6,000 samples per second. Four bits of sample "depth" give us 16 levels of voltage resolution, which will produce listenable speech. Six or eight bits are much better. So, we're still talking about 24,000 to 48,000 bits per second, which is an awful lot. Remember, though, that a bit is not the same thing as a Hz. It is possible to send many bits per second over a limited bandwidth, although it gets tricky if you push it too far. 9600-bits-per-second modems are increasingly common over the telephone and VHF/UHF packet links, but even that is too slow for real-time speech of decent grade. Is there another way out?

Squish

One of the hottest technologies today is data compression. If you use a computer, you may have seen a form of it in the ZIP or ARC programs. These programs compress files into a smaller size. When you decompress them, the original files are reconstructed, with nothing lost. How can that be?

Well, as it turns out, not all the data is really needed. For instance, if your file consists only of text, it does not need all eight bits because there are far fewer than 256 printable characters. Thus, it can be coded to get about 1.5 characters per 8-bit byte, with no data loss. This simple form of data compression is very workable, and there are far more sophisticated systems which can reduce *any* file by an average of 50 percent!

There are other methods of data reduction which are particularly applicable to voice and video data. A great one is "delta modulation." In this scheme, only the *changes* in the incoming analog signal are coded. This works especially well for video because pictures usually contain lots of identical or similar areas. Instead of sending the same byte over and over, the delta modulator simply sends it once: analog with a code telling the demodulator how many times it is to repeat.

A combination of delta modulation and data compression can tremendously reduce the amount of data required to reproduce adequate sound. In fact, Sony's new Minidisc pocket digital recorder reduces the data by 80 percent before recording it! And that's for hi-fi sound. Imagine what we could do with voice-grade signals.

Oops, Missed

One problem with digital encoding is that missing data causes far worse glitches in the reconstructed audio than a similar amount of missing analog information. I know that seems contradictory to the performance of CDs versus LPs (remember those?), but it's true. The problem was recognized early in the development of the disc and solved with a technique we may be able to use. It's called "interleaving."

Spread It Around

On a CD, there's lots of redundant information, along with checksums similar to those used in packet radio. A checksum is simply a number which tells the decoder how many bits there should be if they all are correctly read. Thus, the system knows when something's missing, but not what it is. More sophisticated techniques actually let the decoder fill in and correct some missing information. But still, if a decent chunk gets lost, there's gonna be a nasty noise in the resulting audio. Interleaving is simpler than it sounds. It just means that the data is not recorded sequentially. For example, the first bit of a byte may be followed with the first bit of the next byte. After, say, eight of them, the second bit of the first byte is stored, followed by the second bit of the second byte, and so on. Why do it? Because, by spreading each byte over a larger area of the disc, or a longer span of time over the air, the chances of losing a significant portion of any one byte are tremendously reduced. That's why scratches in a CD don't mess up the sound at all unless they're bad enough to cause the laser to skip an entire track. Of course, it takes longer to retrieve an interleaved byte, so there's a delay between the time you start reading it and the time you can turn it back into analog. On a CD, it doesn't matter, because you don't know and don't care when it was read off the disc.

If we apply the same idea to radio transmission, though, it does matter. A delay of only a quarter of a second should be acceptable, but a one-second delay would make conversations very awkward. On the other hand, the longer the interleave period, the better it works at keeping noise bursts and QRM from destroying the data.

Well, there's more to discuss, but I'm out of room. See you next time. 73

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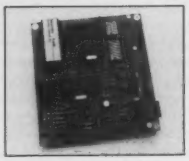

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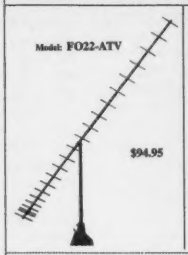

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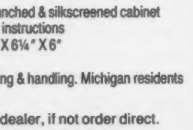

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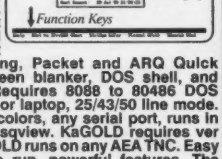

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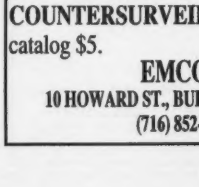

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Bag Those Foxes: Antenna and Hunt Ideas

What's the fastest growing special interest group in amateur radio? It's hard to say for sure, but it just might be radio direction finding (RDF) contesters. You'll hear them called hidden transmitter hunters, foxhunters, bunny hunters, or simply T-hunters.

Hams learn RDF techniques so they can solve RFI problems or track down jammers and bootleggers, then discover that it's a lot of fun to go mobile DFing just for the sport of it. In the last month, I've heard from newly formed or growing T-hunt groups in El Cajon (CA), Memphis (TN), Dayton (OH), Los Gatos (CA), Amherst (NY), Columbus (OH), and Fremont (CA).

Photo A. If you turn on a hidden transmitter near Bolivar, Missouri, you'll be found in short order. Jim Strader KF0ØL and Gary Harrison WAØRWS are ready to hunt.

Traditional mobile VHF T-hunts involve a single well-hidden "hare" and a group of "hound" vehicles trying to find it. To win, they must get there in the shortest time or with the fewest miles traveled, depending on the rules. Usually, all hunters start from a common hilltop, although "start anywhere" is practical for first-finder-wins events.

You don't have to live in a big city to have foxhunt fun. There are only 4,000 households in Bolivar, Missouri, but regular hunt competitions are on the ham club's calendar there. Gary Harrison WAØRWS sent me photos of the 2 meter RDF equipment they use. Hand-rotated strung-wire quads are the antenna of choice (Photo A). They are easy to make from PVC pipe and Fiberglas spreaders.

Rather than drill a hole through the roof of his wagon, Gary came up with a clever window mount using inexpensive PVC pipe (Photo B). It attaches to the roof rack with hose clamps so it's easy to remove after the hunt. He can hunt in almost any weather because he made a Plexiglas panel to fill the void left by the partly open window.

Build or Buy?

Yagis are also popular as T-hunt antennas on 144 MHz and up. Three- to six-element home station models by Cushcraft and KLM have been used with success by hunters in my area. One disadvantage they share is that they aren't made to be quickly disassembled and stored between hunts. That's why I was interested when MFJ Enterprises (P.O. Box 494, Mississippi State, MS 39762; 601-323-5869) announced a new portable three-element beam.

Unlike most VHF yagis, the MFJ-1763 boom is not made of aluminum tubing. It is a long box-like enclosure with threaded inserts to accept the elements. They attach or detach in seconds. Your feedline connects to the SO-239 at the rear. Inside the boom box are a matching capacitor and a ferrite bead balun. The balun gives excellent feedline decoupling for a good pattern, which is important for RDF use.

MFJ uses a chemical film process to protect all the aluminum parts. In my area, outdoor aluminum antennas are pitted and corroded in just a few months by salt air, so it will be interesting to see if the process prevents that from happening to this one.

I mounted the MFJ-1763 atop the van with a PVC pipe mast, just like the other antennas I've tested over the years (Photo C). The feedline goes down the mast, running only 4-1/2 inches from the driven element, but this did not appear to affect the yagi pattern. For regular use, however, it would be better to route the coax down behind the reflector.

The front-to-back ratio was 14 dB, which isn't stellar, but it's adequate. It's the difference between 3/4-scale and near zero on S-meters in most VHF-FM rigs.

The portable yagi is lighter and easier to turn by hand when stopped, compared to my usual four-element quad. But when driving at highway speeds, the boom box makes it "weather vane." Because the mast connection point is behind the driven element, it wanted to point to the rear. It took a lot of force to keep it pointed any other way.

Since successful hunters spend most of the time moving toward the T instead of away from it, I tried to offset this effect by bolting a vertical vane of thin aluminum sheet to the rear of the boom, using the holes provided for rear mast mounting. It took about 20 square inches of material to eliminate the tendency to point backwards.

The acid test for the MFJ-1763 came on the Southern California "Pathfinder" transmitter hunt in March. WA6OPS and I successfully found the T, but we didn't have the lowest mileage. We got fooled by some dead-end streets, but the MFJ beam can't be blamed for that.

Hiders AF6O and KI6FG were 21 air miles away from the starting hilltop, running only a few watts on a rocky power line access road. Because of the wide spacing, the MFJ-1763 has about the same gain as the typical four-element quads that are popular with local hunters. It picked up and tracked this fox just fine.

Free-For-All Contesting

Southern California T-hunters—many of whom believe that the longer a hunt lasts, the more fun it is—have just invented a new way to have a full day of RDF enjoyment.

The Free-For-All (FFA) hunt is unique because each hunting team is also a hiding team. The fun begins early Saturday at a restaurant in the central part of the hunt area. After breakfast, each team leaves to hide its transmitter.

About an hour later, the Southern California coordinated T-hunt frequency (146.565 MHz) comes alive, as one by one the fox-boxes begin their transmissions. After activating its hidden T, each team rushes off to try to be the first to find all the others.

Each of the recent FFA hunts has brought out about a dozen vehicles. Despite the need to deposit their T's quickly so they can start hunting, the teams manage to find challenging spots to place them, usually by scouting in advance of hunt day.

If you think this sounds like fun, your club may want to consider some rules for the hunt, to suit your area and the skills of your local RDFers. You could set up boundaries, limits on transmission duration/timing, and some sort of scoring system.

To the FFA aficionados of Southern California, however, boundaries and rules are unnecessary and a nuisance. The few rules that may be imposed on a particular FFA are made up over coffee on hunt morning. Usually, the only requirement is that each team must hide at least one T before starting to hunt. It should be on the air within an hour after breakfast. Everything else is unpredictable, and that's the way they like it.

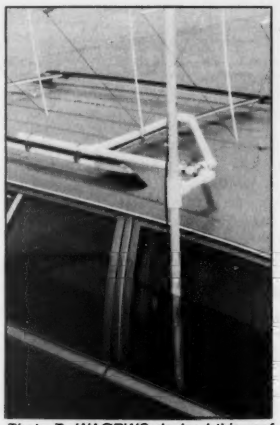

Photo B. WAØRWS devised this roof rack mount because the rigid headliner in his wagon eliminated the possibility of a through-roof hole. Note the plastic panel to keep weather out.

Such an attitude leads some teams to search for opportunities to be outrageous. Foxes with packet transmissions and fraction-of-a-second pulses have been used. Some teams hide multiple transmitters, within yards of each other or miles apart. Hiders have used clock-timers on low-power T's at distant mountaintops, timed to start transmitting shortly after breakfast.

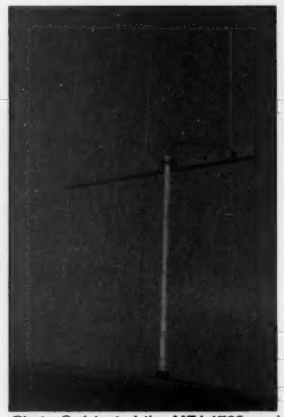

Photo C. I tested the MFJ-1763 yagi with a PVC pipe mast on the T-hunt van. You can have horizontal polarization by using the other set of holes for the U-bolt.

Organized Chaos

A dozen T's on one frequency? It's tricky, but practical. Each T beeps for only a few seconds, then it's silent for a minute or so. Hiders program their controllers (see the sidebar) with different on/off ratios, so the transmissions of the various T's are out of sync and "doubles" are random.

Hiders leave clipboards or notebooks near their T's so hunters can sign in as they arrive. The hunt ends

when everyone finds all the transmitters or gives up. Participants stay in contact on the hunt frequency, although most of the things they say are intended to mislead more than to enlighten. Often, the last team to find a particular transmitter is instructed to pick it up and bring it home.

The Southern California FFA hunt is clearly designed for advanced hunters, but some form of FFA hunt might be a refreshing change of pace for your local hunt group. Next time the hunt day approaches and the designated hider can't participate for some reason, announce a Free-For-All instead.

Many clubs around the country have built one fox transmitter or control box to be passed on to the hider before each contest. Before your group can hold a FFA hunt, every team must acquire some sort of controller unit. The sidebar gives information on easy projects.

Thanks to all who have sent in their foxhunt stories and photos. Keep 'em coming. Let's continue to spread the word on the joys of RDF. 73

Join the Free-For-All

It's easy to build a controller to identify and time the emissions of your hidden T. Here are some projects to choose from.

1. The Auto-Fox by WB6GTM sends the T's callsign over and over in MCW. The callsign and on/off times are programmed by setting 64 DIP switches and two pots. It's in *73 Magazine*, August 1985, page 48.

2. The Un-Music Box plays a sequence of tones that repeat every six minutes. Transmissions are continuous or on 15 seconds out of each minute. It IDs in MCW every 10 minutes from a CMOS shift register, easily programmed with three toggle switches. It's on page 193 of *Transmitter Hunting—Radio Direction Finding Simplified* by KØOV and WB6UZZ, published by Tab Books (#2701), available from Uncle Wayne's Bookstore.

3. N6MBR's TBOX features micro-processor control, three-tone patterns, and user-selectable on and off times. MCW ID is sent in every transmission, regardless of length. The built-in firmware is menu-driven from the serial port of your computer. A clock/calendar chip is optional. "Homing In" for October 1991 has the schematic and information on boards and firmware.

Remember that FCC rules require a control operator at the control point of every amateur radio transmitter when it's on the air. This requirement is satisfied if you monitor your foxes and are able to turn them on and off with a UHF control link (See FCC 97.7, 97.105, and 97.213). "Homing In" for December 1990 describes the Fox Controller, which uses an inexpensive UHF pager receiver and simple DTMF remote control circuit to activate and deactivate the T.

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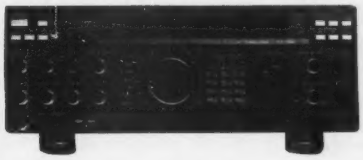

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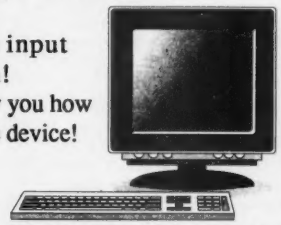

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NEVER SAY DIE

Continued from page 4

were lily white.

Old-timers will remember when Clif Evans published some of the Doyle Letters, exposing the contempt with which the directors held the members and the means by which the ARRL officers totally controlled the elections. These letters made it clear that even then the mind control of the members was well established, and had been since Hiram Percy Maxim ran the outfit in the 1930s. Maxim was not only the founder of the League, but also of a film organization . . . which is probably where he learned about the power of subconscious messages. Maxim was a genius and way ahead of his time.

Do I read *QST*? Oh, I look through it now and then, but then I know the secret for canceling out subliminal messages, so I don't have to worry. How can you tell if you've been reached? Easy, how mad do you get when I seemingly attack the ARRL? Does it bother you when I mention that I hold the ARRL almost totally responsible for the loss of our American consumer electronic industry and for the emergence of Japan as number one in the financial world?

Do you really think it's a total coincidence that the ARRL's Incentive Licensing rule change came at the exact same time as the demise of all our greatest names in radio manufacturing such as Hallicrafters, National, Hammarlund, Millen, Thordarson, Stancor, World Radio, Eldico, Eico, Collins, Central Electronics, Sideband Engineers, Webster, Lakeshore Industries, Lafayette, Johnson, Barker & Williamson, Technical Materiel, Arrow, Clegg, Polytronics, MultiElmac, International Crystal, P&H, Harvey Wells, Telrex, etc.? That's a whopping coincidence, eh?

I have flatly refused to ever let any subliminal ads be run in *73*, even when I had to lose an advertiser in the process . . . like a certain antenna manufacturer I could mention.

How much is your subconscious controlling your life? "No, not me," is the conscious mind response. Sure. So there's nothing that makes you mad, no phobias, no irrational responses. No urge to talk too much . . . or to not talk much? No urge to eat, even when you're not really hungry? No instinctive like or dislike of some people? No fear of heights? No orientation problems? Sure.

Worse, the subconscious mind is not a thinking mind. It's completely reactive. It works on the instructions it's received, not on reason. It accepts as law instructions it's been given, no matter how outlandish. Is it any wonder that almost everyone is "crazy" in some way and to some extent?

Only psychologists trained in tapping into the subconscious and finding these hidden instructions can explain why people do what they do. Only they can explain why people like Jeffrey Dahmer do what they do with any certainty. Is Jeff insane? He certainly acted peculiarly, but this gets to the heart of a touchy legal matter: insanity.

The same subconscious instructions which make us all act oddly are also quite capable of making us sick and killing us. Indeed, at the heart of every disabling illness lies a subconscious root. Even most illnesses tied to genetic weaknesses still need to be triggered into action by the subconscious mind.

It's very simple, once you know how, to get into direct communication with another person's subconscious and not only discover the instructions embedded which are causing troubles and illnesses, but also to erase these instructions. Indeed, it is so simple to find these subconscious instructions that we'll eventually have computer programs able to do it and not even need trained psychologists.

In a few years you'll be seeing computers automatically taking your medical history when you go to a doctor's office . . . and a big part of the information the computer will get is the root subconscious cause for the illness that brought you in. This will allow the doctor to not only treat your symptoms and any germs or viruses at work, but also the underlying psychological trigger.

If we can ever get doctors seriously interested in preventive medicine we may start cleaning up the mess in our subconscious mind which weakens our immune system, triggers genetic weakness problems, causes obsessive behavior, and even helps us to have "accidents."

Meanwhile, how much of your behavior is completely rational? How much seems rational to you, but not to others? And how much is being influenced without your knowledge by subliminal messages?

Did I ever tell you about the radio announcer I worked with who had to give a little cough every time he went on the air? He had to have a switch put in to cut off his mike for these coughs. In therapy we found the instruction deeply embedded by his mother. It said, "Every time I get nervous I have to cough." Once I found the instruction in his subconscious and erased it, he never coughed again.

During my years as a professional psychologist I never found any patients without subconscious instructions that were bedeviling their lives. The process for discovering and erasing all this baloney in our subconscious minds isn't complicated, it's just that I don't know of any psychologist who knows how to do it. The main problem is that this approach cures people of almost anything in a few hours instead of taking years, so there's no way to make much money with it.

Isn't it a bit frustrating to know that you are being run like a puppet by your subconscious mind, blindly and unknowingly obeying long ago installed instructions . . . and perhaps endless subliminal messages?

Now let's see, were's my *QST*, so I can flip through and see what they're up to this month. Heh.

How To Get What You Want

"Oh. I just haven't time." How often do you say that? Just imagine the marvelous things you could do if you had the time to do them. Well, the fact is you *do* have the time. Plenty of it.

People marvel at all the things I do. How do I ever have the time to run about 30 companies, write editorials for 12 publications and also write a book in my spare time? Yet I seem to manage to get out and ski, scuba dive, cook a mean meal, and travel a bunch. Superman? Hardly. Ask any of my detractors.

Nah. I just try not to waste much time. If you keep at it it's incredible how much you can get done. You can do just about anything you want if you decide it's important. You can become an expert on digital electronics, on packet radio, on spread-spectrum, on security equipment and circuits . . . anything.

At work, do you amaze people with how much you get done? Or disappoint them with how little? As I write this I've just finished writing a couple editorials for my *Music Retailing* publication which goes to about 10,000 record stores . . . explaining about training and motivating clerks, avoiding employee theft, sponsoring some local performers and groups and how to get more store traffic.

I also knocked off a report for the Economic Development Commission on the present position and future of trade unions . . . and another on a proposed *Educational Resources* publication which would list and review available educational satellite programs, videos and other such distant learning resources.

How can you get a bunch more done every day? That's easy . . . stop wasting so much time. There are so many addictive ways of wasting time . . . things we do without giving much thought. Take TV news, for instance. Total waste of your time. Ditto newspapers.

But, you protest, you have to know what's going on. Of course. I know what's going on, but I get my day-by-day information from one radio news broadcast via NPR in the morning. That tells me the top stories, but without my wasting a half hour watching TV.

If the news is of any importance it'll be in *Newsweek*. That eliminates the need to watch endless rehashing of blather on TV . . . and newspapers.

But gee, there are some good programs on TV. Sure, a few. Tape 'em so you can fast forward through the commercials and watch at your convenience. Be brutal—if it isn't interesting, dump it. This will get rid of all soaps, all talk shows . . . except Jay Leno's monologue . . . and most sitcoms.

Another rule: Avoid the telephone. Huge time waster. Few people know how to get their message across quickly. I prefer to write since it takes much less time. No chit-chat. Well, not much anyway.

By combining your morning shower and shave you can get the whole works done in less than 10 minutes. And by having an office at home you can be at work in seconds. I do 90% of my work at home and keep in touch via fax.

Movies? When's the last time you saw a really good movie? Skip the junk.

There's an awful lot that needs to be done, so think over how much time you've been wasting and start using your time to make a difference in yourself . . . and then in the world.

Code For No-Coders

The sky has not fallen. Our bands have not turned into CB garbage, as predicted by thousands of old-timers . . . well, the bands aren't any worse than they were before the no-coders joined us. It's turning out that our new Techs are some of our better operators.

I'm still getting letters from no-coders complaining about the nasty welcome many have gotten when they tried going to club meetings. The message has been loud and clear . . . you're rotten people and we don't want to talk to you. Thanks heavens not all our clubs are like that. Some have made a special effort to attract our newcomers and help them move up to higher licenses.

Almost every no-coder letter I've gotten has been enthusiastic about tackling the code and moving up to a General class license. Boy, am I surprised! Of course that's just what I said would happen . . . is Wayne right again? Some oldtimers are really going to hate that.

Tackling The Code

The downside of all this is that there are still an enormous number of ignorant hams trying to teach the code. There doesn't seem to be any way to get through to some very numb skulls that learning slow and then gradually speeding up is one of the worst possible ways to learn the code. It's this prehistoric stupidity which has driven off hundreds of thousands of potential hams.

Please explain to anyone who still thinks that's the route to learn the code that we've known for over 30 years that the brain doesn't work that way. This is the way to frustration and madness. It's no wonder the worst mental cases in the hobby have all turned out to be Extra class hams.

Let's say that you want to get your General and Advanced class tickets. That means you want to be able to pass a code test at 13 per.

If you take the old ARRL route you'll first learn the dits and dahs for each character. Then you'll work your way up to five words per minute and pass your Novice and Tech exams. Then you gradually speed up . . . and two things happen.

When you go about it this way what you're doing, looking at it in computer terms, is setting up a look-up table in one side of your brain. Then, as you hear a character, you send the sound over to the other half of the brain to look it up and see what character it is. Then you send the answer back and write it down with the other side of the brain.

This works just fine up until you get to the clock speed of the brain. It won't translate any faster no matter how hard you try. This is the famous wall and it kicks in at around 10 wpm. This is where we've lost hundreds of thousands of potential hams . . . perhaps millions.

The only way past this wall is to go in an entirely different direction . . . and do what you should have done in the first place. The brain, in addition to being able to set up a look-up table, can also be trained to automatically translate for you.

If you've ever learned a foreign language you know how slow it is when you have to translate word by word, looking up the meaning in your memory. It's terribly slow and frustrating, both to talk and to listen. But once you start knowing what the words mean and think in the language, then it's easy. Well, it's the same with the code.

The system I recommend as the easiest way to learn the code is to have a tape (or a computer) and listen to it at the speed you want to be able to copy. Start right out at 13 per or even 20 per. You want to train your brain to automatically translate a certain sound pattern into characters for you. Four dits at 13 words per minute doesn't sound anything at all like four dits at five words per minute. So you turn on the tape and listen for an E . . . a single dit. Every time one goes by, write it down. After a couple of minutes the E's will jump right out at you. So start listening for I's. You'll notice that you start writing the I's, and that you're still writing the E's as they go by. You're on your way.

Many people who start out at 13 per are able to copy solid within a couple days. I've had many hams tell me at hamfests that they mastered 20 wpm in one single day! It's the changing of the sound patterns as you slowly speed up that makes learning the code by the old ARRL method such a bear. If I hadn't gone through all that torment myself I might have been more of a CW fan.

Just by a remarkable coincidence we happen to have the 13 and 20 wpm practice tapes available from Uncle Wayne's. I've made them fiendishly difficult to copy. No plain language. I've mixed letters, numbers and punctuation and made it as difficult as I could. I'll have you laughing as I hit you with one brain-breaker after another. When you get through you'll be good . . . darned good.

I don't provide any cheat sheets. The tapes are not to be used to test your speed. You don't need that. You know perfectly well whether you're copying solid or not. You don't need to check your copy. Copying code is supposed to be fun, not a strain. As soon as you try to push it, missing characters now and then, you're doing it wrong.

Plain copy makes lousy practice material. You want to be able to recognize Q and Z as easily as E and T, so you need the characters to be sent at random. Anyone who can copy my tape will almost fall asleep during a license test it'll be so easy. You need that extra margin to overcome the normal nervousness a test inspires.

Now get out there and fight the bastions of ignorance. Let's get all our new no-coders moving on up to Advanced or Extra. But let's not take a chance on generating another bunch of burnt out brains such as we hear braying on 14.313 or 14.275.

How's Your Code Speed?

While thousands of us are struggling for months to get our code speed up to 20 wpm so we can get that Extra class ticket, the world is on a completely different track. The world is not geared to 20 words per minute, it's handling megabits per second . . . gigabits . . . and now terabits.

Twenty words per minute is one hundred characters per minute. If we go with ASCII with 11 bits per character, that's 1100 bits per minute . . . about 18 bits per second. So here we are Morsing away at a top speed of 18 bits per second in a world whizzing by us at billions of bits per second.

It's not just big corporations teleconferencing via satellites, but more and more smaller companies, the police swapping data, pictures and fingerprints, and even kids in schools networking via satellites with kids in other countries. And they're not just writing notes to each other, they're sending newsletters with pictures and swapping full color camcorder videos.

Computer graphics have gone from black and white line work to full color high definition photographs and are now in full motion. The information bandwidth has been going up as we're cramming more and more digital data through the pipe. It's been going back down as we develop compression technology.

In the world of information exchange we're talking microwaves and satellite repeaters . . . the very frequencies we're using the least and are in the most danger of losing. So while we're sending messages of a few words . . . and screwing those up . . . passing these messages along our traffic nets . . . the world is moving into gigabits per second and sending digitized full-color high-definition video. That's right, some of our kids in schools are doing more communicating than one billion hams all sending simultaneously can do. We're the pony express trying to compete against faxes. We don't need more horses, we need to forget old man Morse and his oat-burner system and go electronic.

Sure, using what we now know about how the brain works, we can learn the code in a few hours . . . even at 20 wpm. But that's 18 lousy stinking bits per second. We've let a bunch of old men sell out our future by focusing us on the past.

The information age of today should be our world. It's a world of digital audio, digital video, multimedia, camcorders, VCRs, CD-ROMs, laser disks, desktop publishing, BBSs, networking, packet, CompuServe, Prodigy, satellites, fiber optics, cable, telephone wires, HDTV, pocket personal communicators, fax, and so on.

So what do I hear when I turn on my radio? "The rig here is an ICOM 735 with a two-element Bandmaster Quad antenna. Please give me your handle again, I missed it in the QRM."

It's almost enough to make a person think when you consider that there are more active users on CompuServe at one time than on all our ham bands combined. Do you think that it's possible we've lost sight of reality?

Now please don't think for a moment that I blame the ARRL for any lack of leadership in all this. That's as fruitless as blaming Congress and the administration for spending all that money and generating the $4 trillion deficit. Since when should we blame our leaders for our problems . . . and for a lack of leadership and foresight? No, we'll keep on electing crooks to Congress and old traffic handlers to ARRL directorships and we'll pay the consequences.

My wife has been enjoying far better QSOs via Prodigy with her little Macintosh Notebook (made in Japan, by the way) than I've been able to manage with my kilowatt and full-sized three-element beam . . . and at considerably less cost. When we travel she takes her Notebook with her and I take my HT. She plugs into the hotel telephone and is on line with thousands of people, while I'm kerchunking vacant repeaters one after the other, looking for someone to tell me what rig he's using.

Businesses are accepting these new technologies, as are more and more schools. Now let's see, where'd I put my rusty old hand key?

If you're interested in what our schools are doing with technology you might get *Smart Schools, Smart Kids*, by Ed Fiske (Simon & Schuster, 1991). Get ready for a nasty surprise. The generation of kids our old-timers has sneered at is running circles around us.

The Maturing Process

Old-timers mourn for the old days when we hams built our own equipment. Have we really gone soft, or is this just the natural order of things?

Well, with everything using ICs and transistors, we can't build the way we used to, right? Baloney! I doubt that really has much to do with it. I suspect it has more to do with the growth and maturation of new technologies.

When a new technology is starting there isn't any commercial equipment, so the pioneers have to build everything themselves out of whatever parts are available, be they tubes or ICs. Then, as interest grows, a few entrepreneurs start producing equipment. As soon as the equipment becomes available commercially that's the end of the pioneers.

In the 1920s we built our own receivers and transmitters. Then came the SW3 receiver from National Radio and almost immediately all receiver building stopped. By the time I came along in 1936 and visited every active ham in Brooklyn (NY), I was only able to find one who'd built his own receiver. Everyone else was using receivers built by Hallicrafters, National, Hammarlund, RCA, Browning Labs and so on.

We still had to build our own transmitters since there were none made commercially until after WWII. Yes, I know about the National 600, but that was so expensive I can't honestly count it. Lordy! It used Thordarson CHT transformers and cost around $10,000 in today' s dollarettes . . . for a 600-watt AM rig.

I lucked into one in 1947 and used it for years on 75m. Then I used the power supplies and modulator for my 2m kilowatt rig on Mt. Monadnock. I put a solid signal into Norfolk, 600 miles away . . . even when the band was closed. There's nothing like 2,000 watts of audio on a 1,000 watt carrier on the highest mountain in Southern New Hampshire to punch through anything.

As soon as reasonably priced commercial rigs became available hams stopped building transmitters.

I've watched the same progression with RTTY, slow-scan, repeaters, VHF equipment, and then computers. Today very few hackers bother to build computers or even accessories, they just buy them and put their devious minds to software development.

It doesn't make sense to build anything which is available commercially. Manufacturers buy parts cheap, have all of the bugs out of the design (supposedly), and the unit has a resale value. If you build it you have a terrible time finding the parts, they cost ridiculously, debugging will drive you crazier, the unit has zero resale value and your friends will not respect you for having to make do with such a piece of junk.

How About New Technologies?

Yep, here's where experimenters come into play . . . or would, if we were developing any new technologies. The pioneers have to invent and build. Alas, pioneers tend to be youngsters and we've gone to a lot of trouble to keep them out of the hobby for the last 29 years. Outside of our new no-code immigrants, who've just started arriving, we have almost no youngsters.

Speaking of our no-coders, I'm not surprised at the arrogance they're meeting at many ham clubs. America has been welcoming immigrants this way ever since the second colony arrived 350 years ago and was snubbed by the first as lowly newcomers. We sneered at the Irish when they ran out of potatoes and came over. Shanty Irish. We sneered at the Italians. We made fun of the Dirty Litvaks (that's what we called 'em), and so on.

Of course after about three generations most of 'em became Americans and the melting pot worked. A few have kept fighting the system, calling themselves Irish-Americans, Italian-Americans, Polish-Americans, African-Americans. Hmmm, I wonder why we don't have Euro-Americans or Togo-Americans. Maybe the African-Americans don't know where their families came from, but it obviously must have been some place in Africa. Things will integrate a lot better when we have more people actually thinking of themselves as Americans.

Hmmm, Omar Sharif is from Egypt. Does that make him an Afro-American? Are white immigrants from South Africa also Afro-Americans?

Well, never mind . . . it was just a thought. I get off on tangents like that when things don't make sense. And freezing newcomers out of our ham clubs sure doesn't make sense. This fanatical worship of a mode of communications which is 50 years out of date continues to amaze me. Twenty words a minute in a 20,000 word a minute culture isn't rational.

Which would you rather read in *73*, about another antenna or digital audio and digital signal processing? Hey, we might have to actually try to think, so let's skip that digital crapola. Right? 73

Number 22 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
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Modifying your PK-232

No doubt about it, the AEA PK-232 has become one of the most popular multimode controllers in use by amateurs. But some people are trying various schemes to optimize its performance for AMTOR/Baudot operation.

I received a letter from Mike Lamb, the CEO of AEA, who addresses this problem. Mike says, "We have been hearing stories of hard-core AMTOR/Baudot users going through all sorts of gyrations hooking up CP-100, ST-6, etc., to their PK-232 hoping for the last dB of signal-to-noise performance. Some have even abandoned their PK-232 for some new 'high performance' AMTOR/RTTY-only controllers.

"I can only assume that the intent is to gain enhanced performance for low-speed Baudot and AMTOR. If that is the goal, I can save your readers some time, hassle, and perhaps even some money. It turns out that we have a relatively simple factory-approved modification that will optimize AMTOR and Baudot performance for the PK-232 by sacrificing 300 baud packet or ASCII.

"Whereas, we have not kept this modification secret, we obviously have not done a good job of spreading the word to hard-core AMTOR or Baudot users because of the reduced versatility.

"We have noted lately that there has been a renewed interest in high performance AMTOR and Baudot modem/controllers. For those users already possessing a PK-232, they can save themselves a great deal of expense by trying the subject modification first. R.F. Harris Engineers evaluated the PK-232 with the modification and found it to equal or exceed virtually any commercial sitor unit on the market.

"The modification consists of simply changing resistors R42, R52, R62, and R72 from 174kΩ 1% to 432kΩ 1%. Should any of your readers not have any 432kΩ 1% resistors, they can send a self-addressed, stamped envelope to AEA with a request for the 'AMTOR PK-232 Modification Kit' and we will return the envelope with parts at no charge, along with four each 174kΩ resistors, should they want to return the unit to its original condition."

We certainly appreciate the information, Mike. The resistors in question are located along the right side of the main circuit board, at the end of each group between integrated circuits U22, U24, U25, and U27, and comprise part of the digital filtering circuitry. If you make this modification, take your time, and use good printed circuit techniques. If you are not skilled in desoldering, DON'T! Ask someone else to put iron to board; you don't want to destroy a good controller by trying to improve it.

Once again, if you would like to receive the resistors needed to do, and undo, this modification, send an SASE to Advanced Electronic Applications, Inc., P.O. Box C2160, Building O & P, 2006 196th SW, Lynnwood, WA 98036. Ask for the "AMTOR PK-232 Modification Kit" as detailed in this month's "RTTY Loop" column in *73 Amateur Radio Today*.

"The Ameritron QSK-5 is an easy-to-install, external T/R switch for linear amplifiers, which adds full break-in operation to a high-powered amplifier."

Programs for the PK-232

While on the topic of the PK-232, John Boles KA6LWC, in San Jose, California, sent along some information via CompuServe. For users of the PK-232, there is a program that is almost a "buy and fly" called PHS300 (about 190K zipped). It is ONLY for the PK-232 and operates in the "Host" mode. There is some limited access to the command line, and it may have to be "fine tuned" to local repeaters or digital links. It handles all modes except NAVTEX, WEFAX or KISS. In the two years that John has been using the program, he does not relate any problems that were program related. It has been available on CompuServe HamNet, and I will try to add it to the collection of programs available from RTTY Loop.

Another program John mentions is ACUTERM, by Bill Kissel N8BA. It has some contest logging features but it too will only work with the PK-232.

It has colors and quite a few "bells and whistles." I'll see if I can find that one, too.

The Ameritron QSK-5

While we are discussing AMTOR and other such modes, MFJ, another of our digital buddies, sent along information on a new product they are touting, which is of particular interest to RTTYers.

The Ameritron QSK-5 is an easy-to-install, external T/R switch for linear amplifiers, which adds full break-in operation to a high-powered amplifier. Modes such as CW, packet, or AMTOR, which require high-speed T/R switching, can now be run with an existing linear amplifier. This totally silent device, which is six times faster than mechanical vacuum relays, can be moved to new equipment as need dictates.

It is silent, electronic PIN diode switching which accounts for the fast operation and sure switch handshaking of the QSK-5. This eliminates hot switching of the amplifier, and minimizes TVI, RFI, and key clicks. There is also an exclusive "Amp Saver" feature that completely turns off your amplifier's plate current between dots, dashes, and words. Your amplifier lasts longer, runs cooler, and works full break-in while running quietly, far surpassing the abilities of mechanical vacuum relay switches.

Electronic PIN diode switching may well be the solution as interdigitated modes require more complex and reactive switching arrangements. The QSK-5, which is installed without internal wiring by plugging in a few cables, addresses this need directly. The unit handles 2500 watts PEP, and 2000 watts in normal amateur service, with an SWR below 1.5:1. In continuous modes, like RTTY, SSTV, or FM, power is limited to 750 watts. An optional cooling fan will allow sustained operation at 1500 watts in any mode.

For more information, contact Ameritron at 921 Louisville Road, Starkville MS 39759; toll-free telephone (800) 647-1800.

Interest in the various software packages discussed here in the past few months remains at an all-time high. Once again, if you would like to receive copies of the software discussed, for IBM PC compatibles, send a self-addressed, stamped disk mailer, $2 in US funds, and a disk, either 5" or 3", to me at the above address. High-density disk users (1.2M or 1.4M) have been known to receive extra goodies to fill up those vacant bytes, so there is an advantage to using high density disks if you can.

John Boles, who helped us out with software finds above, also points out that with regard to the Baycom modems, Craig Rader N4PLK has kits available, with schematics, for the Baycom modem. Kits are $45 + $2.50 s/h U.S., $5 outside the U.S.; fully assembled units are $55 + $2.50 s/h U.S., $5 outside the U.S. Of course one should write Craig for the latest prices, at 385 Cherokee Court, Altamonte Springs FL 32701.

Similarly, I have found quite a few of you interested in America Online. Users of IBM PC compatibles need a mouse, EGA, VGA, or Hercules graphics, and a hard drive to access the system. Terminal programs are available for PCs, Macintosh systems, and Apple II computers. If you are unable to contact them yourself, I will be happy to have a starter package sent to you directly. Just send me your name, address, and telephone number, computer type, and, in the case of PC compatibles or Apple II, disk size (5" or 3").

In the meantime, I look forward to more goodies next month. Spring is in the air here in Baltimore, and while baseball season is the big local news, there's plenty to do in the hamshack as well. Let me know what you're doing via mail, on CompuServe (ppn 75036,2501), Delphi (username MarcWA3AJR), or America Online (screen name MarcWA3AJR). 73

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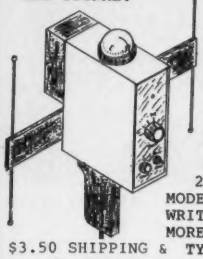

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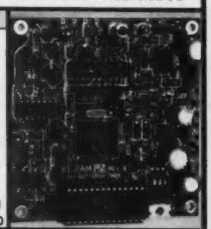

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QCWA as a Resource

Most thoughtful adults in the world today would agree that children are our most important natural resource. We who are involved in education are constantly looking for new ways to stimulate and hold the interest of youngsters in our classrooms. One of the best methods for motivating a group of young people is to have a lively demonstration or presentation by an enthusiastic guest speaker. No matter how expert and excellent the primary teacher or instructor may be, there's nothing so refreshing as a change of pace with a different speaker in front of the room. Besides bringing in a new face and a different personality, the guest you invite can provide a different expertise and a new way of looking at things. If properly planned, your guest speaker can give your class or group just the extra little excitement and motivation they may need.

During the last 12 years of teaching 6th, 7th, and 8th graders, I've discovered that one of the best resource pools of talented, dedicated, and gracious amateur radio operators is the Quarter Century Wireless Association (QCWA). I count many of its members as my friends today. Whenever a call for help in the classroom was put out, assistance was always forthcoming from this group. Their membership has within its ranks all the history and enrichment of radio. They are the guardians of all that went on before, yet they look to the future in order to perpetuate that which is best about amateur radio.

QCWA has established and funded, through the generosity of its members, a program of scholarships awarded to young men and women in amateur radio who are working toward their formal educations. The program honors QCWA Silent Key members, in whose name the scholarships are issued.

Carl Felt Jr.

One of the most generous and talented individuals I've met through this organization is Carl Felt Jr. N2XJ. Whenever I meet Carl at the Hudson Division Cabinet meetings, he's always got some new idea or project to suggest for the betterment of amateur radio. I'd like to honor Carl by sharing some of his unique background in this column.

Photo A. Carl N2XJ and Carole WB2MGP, both assistant directors, at a Hudson Division Cabinet meeting.

Carl Felt Jr. was born on December 18, 1908, in Peking, China, the son of Methodist missionary parents. All his pre-college schooling was at the Peking American School, with the exception of his furlough years. One of the most fun things Carl remembers from those early years was in 1921 when radio broadcasting was just starting and his aunt gave him a crystal radio set kit for Christmas. He remembers that KDKA, WGY, etc. were on the air, somewhere around 360 meters. There was also a station on Bedloe's Island operated by the Army on a much longer wavelength.

Carl's family was in this country for a while, and his father kept encouraging his interest in radio. When they returned to China in 1922, Carl had a full set of honeycomb coils and a detector and one-step amp. He and a friend learned the code from a *Boy Scout Handbook* and set up battery-operated Ford spark coil stations. They could talk across town in Peking. Carl's call was XJ, self-assigned and without benefit of any authorities. They practiced the code by listening to commercial stations, especially the ships plying up and down the China coast. Carl remembers his dad's surprise when he showed him some messages in German (which he didn't know) that he'd copied. Then he believed that his son was really doing something in his attic shack!

In addition, the honeycomb coils enabled him to listen to the longwave arc stations . . . NPO in Cavite; NPG, NPM in the Philippines, Guam, and Mare Island, California, respectively. Carl regrets to this day that he was not in China when worldwide DX came to the ham bands!

Back in the U.S., Carl graduated from Cornell College where he met his wife of 61 years. During the Depression in New York City, he felt he was lucky to get a job at $25 a week with the *Daily News* in its advertising department. It led to a 43-year career in advertising . . . except for a four-year hiatus for WWII. Despite having a wife and three young girls, Carl got patriotic and applied for a commission in the Navy. He thought he could be a communications officer since he'd been licensed since 1928 as W9FJA while in college. But the Navy was more interested in his foreign background and ability to speak Chinese, so he wound up in the Naval School at Columbia University. There he had nine months of intensive study preparing to be a military government civil affairs officer. The successful completion of the course netted him an M.A. degree in political science.

Carl's service as a Naval officer was very varied and gave him the opportunity to also serve with the Army and Marine Corps. After a period of sea duty in the Atlantic on a destroyer escort, he was assigned to the Office of the Chief of Naval Operations; after that to Pearl Harbor, and then transferred to the 10th Army. Carl heard rumors that the 1st Marine Division was going back to North China. He jeeped up to 1st Mardiv headquarters, applied for a job, and was transferred just in time to leave for a return to his old home!

The U.S. mission in North China was to accept the surrender of the Imperial Japanese forces without taking sides between the Nationalists and the Communists. The Division did discharge its many tasks, one of which was to assist in the repatriation of Japanese military and civilian personnel from North China to Japan. Carl was made repatriation officer of the 1st Marine Division, based in Tientsin, and given the responsibility of organizing and directing the repatriation of the Japanese. At the peak of the operation, the division was shipping out 6,000 Japanese per day. During the time Carl ran the Division, he saw more than 500,000 Japanese returned to the island from which they had come.

When Carl came back home again, he spent his time catching up with family matters and his business career. He remained in the Naval Reserve and retired with the rank of captain in 1968 when he was 60 years old! He also returned to amateur radio. Carl recalls that much had changed. Even Chatham, New Jersey, which had been in the 3rd call area when the WWII shutdown came, was now in W2-land. When the "N" calls came and Carl got his Extra class ticket, he got his old XJ call back with an "N" in front of it.

Carl believes he would never have volunteered for the Navy if he hadn't have been an amateur radio operator. He hadn't been especially interested in boating or the ocean, but he did think he would have made a good communications officer. To this day, Carl feels that he has amateur radio to thank for a second career which has given him great experience in the service of his country. It's also proven itself to be a hobby that he's always enjoyed and will continue to enjoy as long as he lives.

Just think about the enrichment that radio operators of Carl Felt's caliber can provide to a group of youngsters. Consider inviting them to your classes and club meetings!

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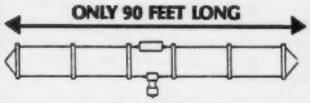

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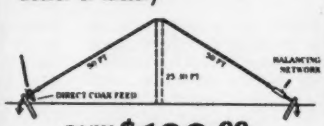

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2RU7	3.50	7	33.60
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CIRCLE 178 ON READER SERVICE CARD

RANDOM OUTPUT

David Cassidy N1GPH

FCC Enforcement

For years, the FCC has maintained that there is very little money and staff available to enforce the rules on the ham bands. With limited resources, the FCC must set certain priorities, beginning with matters of public safety. Of course, the FCC's first enforcement priority is, and should be, investigating interference effecting law enforcement, public safety, aviation and other life, death or property services.

If you've read this column more than once, you know that I feel amateurs should be self-policing. Since the FCC doesn't like to be bothered by the petty problems of amateur radio (and most of them *are* petty), it only drives another nail into amateur radio's coffin, every time one of us bugs the FCC with a minor infraction, pet peeve or other time wasting complaint. Unless it's positive PR, the less attention we draw toward ourselves the better.

While we amateurs should work to settle our own differences, this does not mean that the FCC can or should wash their hands of the entire Amateur Radio Service. We have some serious enforcement problems—some that have been going on for years—and it is high time the FCC stopped hiding behind the "no money or manpower" excuse and started cleaning up some of these problems.

If the FCC is so poor and understaffed, why is it that they can spend hundreds of thousands of dollars chasing down a bunch of kids broadcasting rock music on the relatively barren frequencies above the 40m band, when we've got hoards of violations happening on the heavily populated 80, 20, 10 and 2 meter bands? I submit that it is not a question of money and personnel, it is a matter of management and priorities—both bad.

I am sick and tired of losing the use of 50 kHz of the 20m band to various forms of vermin, while the FCC spends thousands to chase down harmless "pirates" on 7.415 MHz. I have heard blatant violations of several FCC regulations on an almost daily basis on and around 14.313 for over five years, and with the exception of a few fines, the FCC has done absolutely nothing to solve the problem. It is obvious that this group of idiots is not going to go away on their own. As a taxpayer, I am furious that the agency empowered to clean up this mess puts busting linear-using CBers (because of a handful of complaints) above the continued clogging of a major portion of an international resource. A few hours spent monitoring on a Saturday afternoon would provide ample evidence to revoke the licenses of dozens of these operators.

I am tired of listening to barely disguised commercials for various publications and organizations. I am sick to death of listening to hour after hour of intentional interference, all for the sake of a few contest points. I am at the end of my rope when it comes to amateurs who don't understand that you can't fit 10 kHz of audio into a 3 kHz wide signal.

I'm not the only one who feels this way. Judging from my mail, not to mention the hundreds of hams I spoke with at the Dayton Hamvention (and the hundreds of others at hamfests across the country), the general feeling among ham radio operators is that the FCC is using the "self-policing" excuse to shirk part of their enforcement responsibilities. It's hard for your average amateur to accept the thousands of dollars put into chasing down a couple of teen-agers with a 40 watt AM transmitter connected to a tape deck, when we are forced to put up with blatant and repeated violations by known persons or organizations occurring from one end of the amateur spectrum to the other.

As the editor of the Arlington (VA) 10 - 10 News put it in a recent newsletter, "...something is very wrong when a Federal regulatory agency expends its resources chasing minnows, while the sharks swim free."

There are two reasons why this lack of attention to ongoing violations really ticks me off. First, I just did my taxes. When I figure the percentage of my income that goes to Washington every year and then figure the value I'm getting for my investment, it makes me want to scream. The fact that I am an Amateur Radio Operator has very little to do with it. I am a taxpayer, paying for the operation of the FCC, and don't like the way they are setting enforcement priorities. Second, as an Amateur Radio Operator and proud citizen of the United States, I feel that rules violations that occur on bands where propagation insures that the violations are being heard all over the world should be given more priority than a CBer getting into his neighbor's $20 telephone.

I am not advocating that thousands of you start writing to the FCC, demanding action on whatever has got your goat this week. This will make us no friends in Washington and only serves to clog up the works (since every complaint, no matter how real or imagined, must be answered). What I am saying is that you, I and the FCC are well aware of several ongoing violations of Part 97. It's about time the FCC did something to clean up these messes.

The time for reading about these fools in the amateur radio press (and we all know who I'm talking about) is over. The time for passing out fines is over. Certain problems have gone way beyond the realm of "self-policing." Now is the time for the FCC to clean house a little, and they can start with the cesspool on twenty meters. Now is the time for certain hams to lose their licenses, and for several to spend some time in jail.

When they're through rounding up the hooligans on 20 meters, how about it if the FCC spends a few contest weekends tracking down the illegal power operators and intentional interferers. If they did this over the course of six or eight major contests, maybe contests would once again become a fun way to sharpen operating skills instead of the display of "who can buy the biggest signal" they have become.

After that, the FCC could spend a couple of days listening to that repeater out in LA (you know the one I'm talking about—it was in all the papers). It wouldn't take much monitoring to get the evidence necessary to revoke the trustee's license and shut down that embarrassment.

While they're at it, why don't a couple of monitoring stations put on a pot of coffee and spend a few late nights listening to the filth that has become the 80 meter band (if you think this contradicts what I've written about the First Amendment, go back and read it again)?

The concept of a "self-policing" service, which is a nice thought, is and always has been a myth. You cannot enforce regulations without the legal authority to back up that enforcement with punishment. It's time for the FCC to give up the convenient lie of amateur radio being self-policing and to start giving the amateur radio taxpayers their fair share of protection from illegal operators.

The FCC has the authority. I hope they start to wake up to their responsibility. 73

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

HF propagation conditions for June 1992 are liable to be the worst in a long time! The reason for such a gloomy prediction is the seasonal "HF Doldrums" one can expect in June, plus the decline of the sunspot cycle, and some forecast periods of extremely unsettled conditions related to the earth's magnetic field. All of these, of course, relate to the sun itself...some directly and some indirectly.

The days of June 6th, 10th and 16th are likely to be the focus of some extreme ionospheric upsets on, or a day or two before or after, these dates; which is the closest I can come at the time of this writing in March. For hams who are interested in relationships between the sun and other geophysical events, look for possible earthquakes, volcanic eruptions and violent atmospheric storms around these dates, and particularly VLF or ULF "signals" and perturbations of same.

The chart shows which days are likely to be the worst (P), those which might be acceptable (F), and those which might be good (G). Daytime best bands will be 17 and 20, with much short skip and some DX. Bands between 30 and 160 will be virtually useless during the daytime. At night, you can count on 20 meters to be open for DX some evenings, and the bands between 30 and 160 open variably, depending on atmospheric "noise," i.e. QRN.

There will be a partial eclipse of the moon on June 15th, visible from Antarctica, North (except extreme NW) America, Central and South America, as well as East Africa, Eastern New Zealand, and the southern tip of Greenland. On June 30th there will be a total eclipse of the sun with totality observable only from West Africa and Central America. The summer solstice and longest day will occur on June 21st, and a full moon on June 14th.

I hope these gloomy predictions for June propagation DON'T come true, but let's wait and see. It could be a very GOOD month for VHFers who will find some conditions much to their liking. Always listen to WWV at 18 minutes past any hour for current updates on solar-geophysical data and announcements of importance. See you next month. W1XU. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	—	—	—	—	—	—	20	—	—	—	—	—
ARGENTINA	20	20	20	40D	40D	—	—	—	—	—	10	15
AUSTRALIA	—	—	—	20	20	40D	20D	20D	—	—	—	—
CANAL ZONE	15	20	20	—	—	—	20	20	20	—	10D	15
ENGLAND	20	—	40/fb	40/fb	—	—	—	—	—	20	20	20
HAWAII	15D	20	20	20	40D	40D	—	—	—	—	—	15D
INDIA	20D	20D	—	—	—	—	—	—	—	—	—	—
JAPAN	—	—	—	—	—	—	20	—	—	—	—	—
MEXICO	15	20	20	—	—	—	20	20	20	—	10D	15
PHILIPPINES	—	—	—	—	—	—	20D	—	—	—	—	—
PUERTO RICO	15	20	20	—	—	—	20	20	20	—	10D	15
SOUTH AFRICA	—	40	40	20D	20D	—	—	—	—	—	20D	20D
U.S.S.R.	20	30/fb	30/fb	—	—	—	—	—	—	—	20	20
WEST COAST	40	80	—	—	—	—	—	20	20	20	15	40

CENTRAL UNITED STATES TO:

ALASKA	—	—	20D	—	—	40D	—	20	—	—	—	—
ARGENTINA	20/fb	20/fb	20	40D	—	—	—	15	15	15	15/fb	20
AUSTRALIA	15D	15D	15/fb	20	20	40D	20	20	—	—	15D	15D
CANAL ZONE	20	20	20	40D	40D	—	20	20	15/fb	15	10D	10D
ENGLAND	20	—	40D	40D	—	—	20D	20D	—	—	20	20
HAWAII	15	15	20	20	20	40D	20	20	—	—	—	15D
INDIA	20D	20D	—	—	—	—	20D	20D	—	—	—	—
JAPAN	—	—	20D	—	—	40D	—	20	—	—	—	—
MEXICO	20	20	20	40D	40D	—	20	20	15/fb	15	10D	10D
PHILIPPINES	—	—	—	—	—	—	20D	20D	—	—	—	—
PUERTO RICO	20	20	20	—	—	—	20	20	15/fb	15	10D	10D
SOUTH AFRICA	—	—	40D	20D	20D	—	—	—	—	—	—	—
U.S.S.R.	—	—	—	—	—	—	20D	20D	—	—	—	—

WESTERN UNITED STATES TO:

ALASKA	—	—	—	20	20	20D	40D	20D	20D	—	—	—
ARGENTINA	15	20D	20	20	—	—	—	20D	—	—	—	15
AUSTRALIA	15	15	15	20	20	30/fb	40	30/fb	—	—	—	—
CANAL ZONE	10D	15	20	20	40D	40D	—	20	20	—	15	10D
ENGLAND	20	20	20D	—	—	—	—	20D	—	—	—	20D
HAWAII	15	15	15/fb	20	20	30/fb	40/fb	—	20	—	15D	15
INDIA	—	—	20D	20D	—	—	—	20D	20D	—	—	—
JAPAN	—	—	—	20	20	20D	40D	20D	20D	—	—	—
MEXICO	10D	15	20	20	40D	40D	—	20	20	—	15	10D
PHILIPPINES	—	—	—	20D	20D	—	—	20D	20D	—	—	—
PUERTO RICO	10D	15	20	20	40D	40D	—	20	20	—	15	10D
SOUTH AFRICA	—	—	—	20D	20D	—	—	—	—	—	—	—
U.S.S.R.	20D	20D	20D	—	—	—	—	20D	—	—	—	—
EAST COAST	40	80	—	—	—	—	—	20	20	20	15	40

Note that a (D) will indicate a difficult path. Try on days when the geomagnetic field is quiet (G) and when solar flux is 100 and greater.

JUNE 1992

SUN	MON	TUE	WED	THU	FRI	SAT
	1 P	2 P	3 P–F	4 F	5 F–P	6 P
7 P–F	8 F	9 F–P	10 P	11 P	12 P–F	13 F
14 F	15 F–P	16 P	17 P	18 P	19 P–F	20 F
21 F–P	22 F	23 F	24 F–P	25 P–F	26 F	27 F
28 F–P	29 F	30 F–G				

ICOM BATTERY INSERTS			
BP-3	8.4v	270mah	$15.00
BP-5	10.8v	500mah	$21.00
BP-7	13.2v	500mah	$23.00
BP-8	8.4v	800mah	$21.00
KENWOOD BATTERY INSERTS			
PB-21	7.2v	200mah	$12.00
PB-21H	7.2v	600mah	$15.00
PB24 Tabs	9.6v	600mah	$15.00
PB-25/26	8.4v	500mah	$18.00
YAESU BATTERY INSERTS			
FNB-4/4A	12v	500mah	$27.50
FNB-10	7.2v	600mah	$15.00
FNB-17	7.2v	600mah	$18.00
MORE BATTERY INSERTS			
Tempo S2/4/5 Late		500mah	$21.00
San-Tec #142/#144 Tabs		600mah	$22.00
Azden 300 Tabs		600mah	$15.00
Bearcat		600mah	$20.00
Regency MT1000 Tabs		600mah	$15.00
YAESU COMPLETE PACKS			
FNB-2	10.8v	500mah	$19.00
FNB-10	7.2v	600mah	$34.00
FNB-11	12.0v	600mah	$52.00
FNB-12	12.0v	500mah	$45.00
FNB-12S	12.0v	600mah	$48.00
FNB-14	7.2v	1000mah	$48.00
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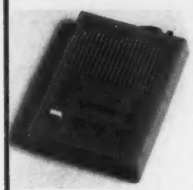

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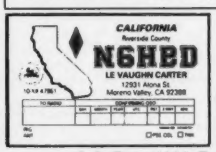

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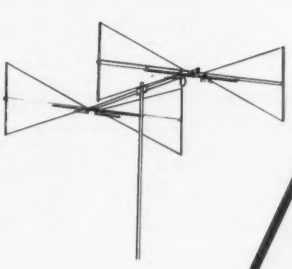

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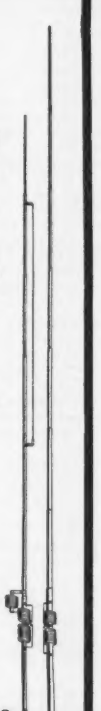

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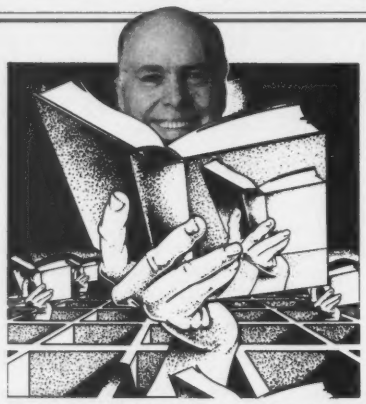

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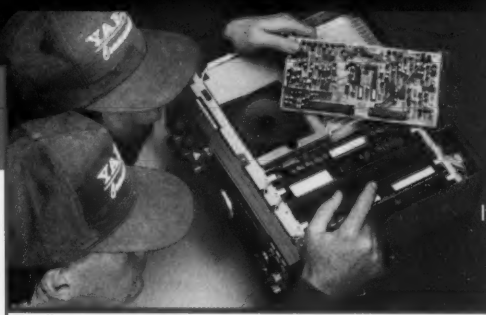

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